Sectional Volume No. 7.

Ministry of Agriculture and Fisheries.

COLLECTED LEAFLETS

ON

BEE KEEPING.

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INTRODUCTION.

Owing to climatic conditions, bee-keeping on a large scale as an occupation has, in this country, found few people who have made it a success. On a small scale, however, it is being practised increasingly by the cottager and smallholder. The city worker, too, living in the country, has found it to be a fascinating hobby, as well as an additional source of income.

The leaflets contained in this volume are designed to inform those who are desirous of commencing to keep bees, and also to assist those who, already having some practical experience, are anxious to keep themselves in touch with modern hygienic methods. They will be revised from time to time, particularly those dealing with the diseases which affect bees, in order that the information given should be kept up to date; and it is hoped that leaflets on other aspects of bee-keeping will be added. Readers are accordingly advised to secure new editions of the volume when published.

London, S.W.1.
September, 1922.

ADVICE TO BEGINNERS IN BEE-KEEPING.

Bee-keeping is an occupation that can be followed on a small scale in one's spare time, and, as only a small space is necessary upon which to stand the hives, it is eminently suitable for smallholders, cottagers, and others with a limited area at their disposal. It also has the advantage of being a suitable occupation for women. Moreover, bees are active pollinators of fruit blossoms, and the keeper of bees therefore renders valuable assistance in the production of fruit.

In comparison with the skep method of bee-keeping followed by our forefathers, the perfection and simplicity attained in the construction of the present-day movable comb hives and appliances mark a revolution in apiculture. When skeps are used, the bee-keeper is compelled to carry out the inhuman practice of killing the bees to obtain their honey, and this, when secured, is full of foreign substances, such as liquid matter from the crushed bodies of the grubs, pollen, propolis, and other substances, which are incorporated with it during the necessary process of squeezing the honey from the combs. The modern system, however, enables any person with ordinary intelligence to follow this lucrative occupation successfully without injury to the bees, combs or brood. Further, natural swarming can be controlled, and if it is desired to increase the number of colonies, this can be done to a larger extent by artificial methods* than if the bees are allowed to swarm naturally, when there is a great danger of the swarm being lost by its issue and escape during the absence of the owner.

First Steps.—One of the first steps to be taken by those desirous of becoming bee-keepers is to obtain a good book on apiculture, and to study it carefully. There are several books from which a choice may be made. It would also be advisable to join the local bee-keepers' association, as in this way much advice and information can be obtained; moreover, secretaries of such associations will be able to furnish names of expert bee-keepers willing to help if needed. The association will also be able to render assistance in many other ways.

The prospective bee-keeper will be well advised to make haste slowly. Beginning with not more than a couple of stocks, he should increase the number as he acquires experience and becomes more capable of dealing with a larger apiary.

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* *See* Leaflet No. 334 (*How to Increase Colonies of Bees*) included in this volume.

Appliances.—The appliances should be as simple as possible, and only those absolutely necessary should be purchased. These consist of a complete hive, containing supers (section racks, or shallow comb boxes), a queen excluder, quilts, ten frames with a division board in the brood chamber, comb foundation for the brood frames and also for the supers, a veil, and a smoker or carbolic cloth for subduing the bees. If the shallow combs are to be used for procuring surplus honey, a centrifugal honey extractor will also be needed, but this will not be required if comb honey is worked for exclusively. A scraper for cleaning floor boards, frame tops, &c., an uncapping knife for use when extracting (a carving knife will serve this purpose), and a bee escape fitted into a board for clearing the bees out of the supers, will also be required.

The Hive.—The outside design of the various hives manufactured differs considerably, but in most cases the interior is of uniform measurement and made to take the British standard frame. A hive should be chosen of simple construction, accurate workmanship and sound material, in order that it may stand permanent exposure to the weather. The outside of the hive should be painted thoroughly to keep it proof against rain and damp. A material aid to this end is to cover the roof (which must be made plain and not from feather-edge boards) with calico stretched as tightly as possible, and tacked securely along the under edges of the eaves and gable ends. This should be done after the first coat of paint has been applied to the hive, so that the calico will receive the subsequent coats. An extra coat of paint should be given to the calico-covered roof.

Double-Walled Hive.—A hive of sound pattern is that called the " W.B.C." Fig. 1 shows the arrangement of this hive, the side of which has been omitted so that the internal fittings are exposed to view. It consists of a floor-board having four splayed legs, and a brood chamber containing ten frames with a division board. These frames hang by ears or lugs on a metal runner, so that there is a space of $\frac{1}{4}$ in. between the end bar of the frame and the side of the hive. This is a bee space, and therefore left clear. If the end bar fits close to the hive side so that the bees cannot pass between, they will fill the crevice with propolis; if more than $\frac{1}{4}$ in. space is given they will build comb between; in either case making it difficult to take out the frames for an examination of the combs. Between the bottom bar and the floor-board $\frac{1}{2}$ in. space is given so that the incoming and outgoing bees have a free passage, and are also able to clean out in comfort both the bees which die and any dirt which accumulates Their natural instinct teaches the bees to leave this space open, and they therefore do not build comb there. To obtain combs of the right thickness for brood rearing, *i.e.*, $\frac{7}{8}$ in.,

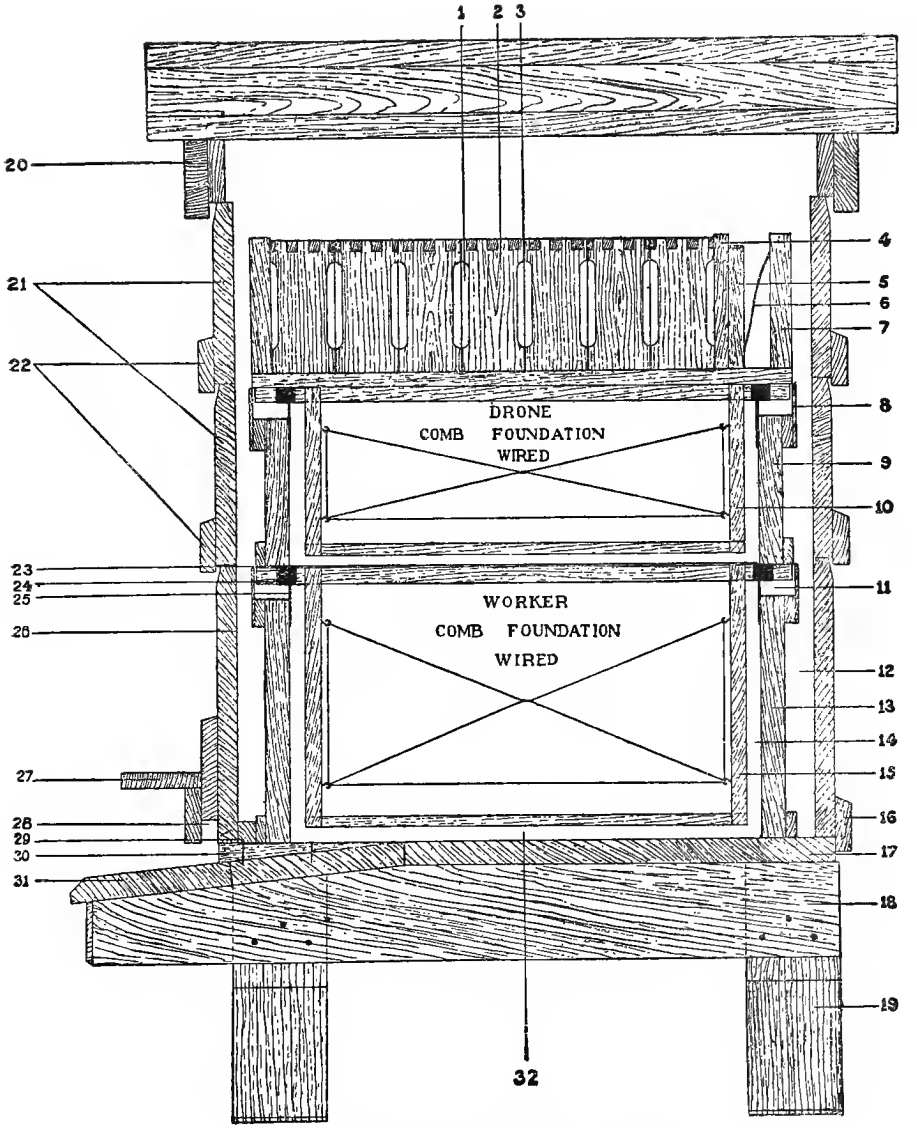

FIG. 1.—DOUBLE-WALLED (W.B.C.) HIVE.

1. Bee way.
2. Section.
3. Metal divider.
4. End following board.
5. Spring block.
6. Spring.
7. Section rack end.
8. Stop for frames.
9. End of shallow frame box.
10. Shallow frame.
11. Rebate under frame lugs.
12. Air space.
13. End of brood chamber.
14. Bee space between frames and hive side.
15. Brood frame.
16. Plinth.
17. Floor board.
18. Floor joist.
19. Leg.
20. Roof.
21. Lifts.
22. Plinths.
23. Queen excluder.
24. Metal end.
25. Metal runner for frames.
26. Outer case.
27. Porch.
28. Groove for entrance slides.
29. Tunnel board.
30. Entrance.
31. Alighting board.
32. Space under frames.

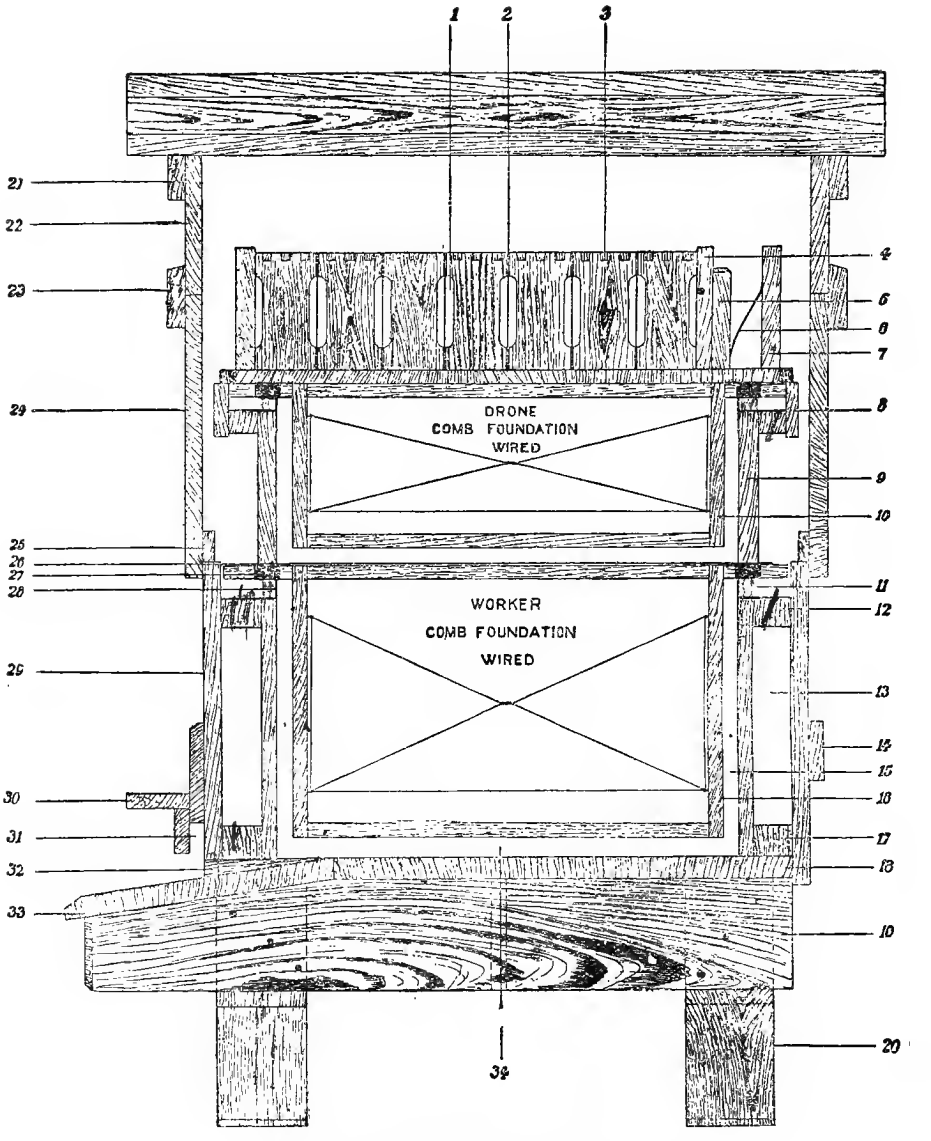

FIG. 2.—SINGLE-WALLED HIVE.

1. Bee way.
2. Metal divider.
3. Section.
4. End following board.
5. Spring block.
6. Spring.
7. Section rack end.
8. Stop for frames.
9. End of shallow frame box.
10. Shallow frame.
11. Rebate under frame lugs.
12. Top block between inner and outer walls.
13. Air space.
14. Stop when reversing lift for wintering.
15. Bee space between frames and hive side.
16. Brood frame.
17. Bottom block between inner and outer walls.
18. Floor board.
19. Floor joist.
20. Leg.
21. Roof.
22. Shallow lift.
23. Plinth.
24. Deep lift.
25. Inner stop for lift.
26. Queen excluder.
27. Metal end.
28. Metal runner for frames.
29. Brood chamber.
30. Porch.
31. Groove for entrance slides.
32. Entrance.
33. Alighting board.
34. Space under frames.

metal ends are fitted on to the lugs of the frames; these are 1½ in. wide, so that when they are in position, and all the frames are pushed together until the metal ends touch each other, there is a space of 1½ in. from the centre of one comb to the centre of the next, allowing for ⅞ in. comb and a ⅜ in. passage between each comb to accommodate the bees when carrying out their work in the summer, and to cluster in during the winter months.

To compel the bees to build their combs in the frames, they are provided with comb foundation. This is pure bees' wax, sheeted and impressed with the base of the cells. By its use, perfectly straight combs consisting of either worker or drone cells can be obtained in any desired position. To make the brood comb strong, wire is first stretched across the frame; a sheet of worker base foundation cut to fill the frame is then inserted into the saw-cut made in the top of the frame for this purpose, and a serrated grooved wheel called a spur-embedder is then heated in the flame of a spirit lamp and run along the wire, thus melting the wax slightly in order that the wire may sink into it. This holds the foundation rigid, and when the comb is built the wire is right in the centre of it, and there is very little fear, either of the comb dropping out if held in the wrong position, *i.e.*, horizontally instead of vertically (as is often carelessly done when manipulating) or of the combs breaking down, should the bees at any time have to be transported by road or rail in their hives or in specially made travelling boxes. The combs which are built in these frames are reserved for the rearing of young bees and the storage of the food upon which the bees live during the winter, and should not be touched for surplus honey.

A second chamber, or *super* as it is termed, contains shallow frames, the combs in which are used for the production of extracted or liquid honey.

The third chamber is a section rack, and contains 21 sections (miniature wooden boxes 4¼ in. square by 2 in. wide) in which comb honey is produced. Each section when filled and sealed holds approximately one pound of honey.

Surrounding these chambers there is an outer case which encompasses the brood chamber and also carries the porch over the entrance; the size of the latter is regulated by sliding doors. There are also lifts which fit on to the top of the outer case, and on one another, to accommodate the supers during the honey season. A roof completes the structure.

The advantages of this hive are its simplicity; the air space between the outer cases and inner chambers, which provides a more even temperature, both in winter and in summer, than is the case with a single-walled hive; its mobility; its accessibility for cleansing and disinfection; and its adaptability to being built up to any height that may be necessary for the accommodation of the supers in which the bees work. Shallow

comb supers or section racks can be used in conjunction with each other, or only one kind may be used on the hive at one time, according to the desire of the bee-keeper. If a larger brood nest is desired it can be obtained by the addition of an extra brood chamber, or a shallow frame box having ten frames fitted with worker base foundation and spaced with 1½ in. metal ends according to the bee-keeper's idea of the extra space required.

Single-Walled Hive.—A cheaper form of hive is the single-walled one (Fig. 2). A comparison with Fig. 1 will show that in this pattern there is an air space only at the front and back to accommodate the lugs of the frames, and not entirely surrounding the brood chamber. There are also various portions which, through the secure nailing of the parts, are inaccessible for disinfection, and the number of supers which it is possible to use in tiering up is limited.

Stocking the Hive.—This should be done as early as possible in the spring of the year. The hive may be populated in three ways, by purchasing (1) a colony of bees, (2) a nucleus, or (3) a swarm.

1. The first is the most expensive method, as the bees have already built the combs, are rearing brood and have stored a certain amount of food. The advantage is that, given a good season and proper management, surplus honey is assured in the first year, and increase may possibly be obtained as well.

2. A nucleus will cost less, as it will consist of four combs (only two, or at most three, of which will contain brood), bees, and a fertile queen, together with the stores, instead of the ten combs of a colony. By judicious management it may be worked into a full colony in time to give a limited amount of surplus before the end of the season. The beginner, as a rule, does not possess sufficient practical knowledge to carry this out effectively.*

3. The safest way for a beginner to start is with a first swarm (not a cast, or after-swarm). The most satisfactory method of purchasing a swarm is by weight. About 5,000 bees weigh one pound; and as swarms average from 3 to 5 lb. each, they will contain from 15,000 to 25,000 old bees with their fertile queen. After-swarms weigh about 2 lb. and have a virgin queen. A swarm weighing 5 lb. should be obtained if possible.

By this method the bee-keeper will avoid all the pitfalls of disease or lack of condition which beset the inexperienced purchaser of established colonies or nuclei, and which only the practised eye can detect. Furthermore, a knowledge of the working of the colony right from the commencement is thereby

* For details as to building up of a nucleus, *see* Leaflet No. 349 (*Methods of Obtaining Strong Colonies of Bees for Wintering*) included in this volume.

obtained. Given a good season, a swarm should be able to establish itself in its first year and may possibly provide some surplus for its owner.

Stocking from a Swarm.—When the box or skep containing the swarm arrives, it must be placed in the shade near the hive the bees are to occupy.

If the swarm is in a box, the box should be placed upside down and the screws fastening the lid taken out. The lid should then be wedged open at one end about half an inch to allow the bees to fly. If the bottom of the box consists wholly or partially of perforated zinc it should be covered with a sack to exclude the light, otherwise the bees will become excited, and may come out and escape.

If the swarm arrives in a skep, the cording and wrap should be removed, and the skep placed on a board with a fair sized stone under one edge, to allow of flight and ventilation. The bees will soon quieten down after the shaking and consequent excitement of their journey, and will then be in a condition for handling comfortably.

Position of the Hive.—The movable comb hive must be made ready for the reception of the swarm previous to the latter's arrival. It should face as near as possible south-east, with a clear flight for the bees, and should be shaded from keen north or east winds. The position chosen should be one where the air can play freely round the hive, and also where the sun's rays will not beat down on it. An ideal situation is by the side of, but not under, a standard fruit tree. It must also be easy of access for manipulating, but the entrance should not face a path or other position where human beings or animals pass, or there will be a danger of their being stung by the outcoming bees. The legs should stand upon bricks to prevent them from rotting. The hive must be set perfectly level from side to side, with a downward inclination of about half an inch towards the front, to throw out the moisture which condenses inside, and to prevent the accumulation of moisture from rain driven in by the wind.

Hiving a Swarm.—In the early evening, say about 6 o'clock normal time or 7 o'clock summertime, the roof and lift in the case of a single-walled hive, and the outer-case surrounding the brood chamber in addition to the lifts if a double-walled hive, should be removed. To prevent the bees ascending from the brood chamber to the roof, and building their combs there instead of in the frames on the worker-base foundation provided (which they are very likely to do, as it is their natural habit to commence comb building from the roof of their home), a thin quilt of ticking or unbleached calico is placed over the frames. The front of the brood chamber should be raised from the floor board about an inch, by means of two wedges. A board, the width of the alighting board, should then be placed in front of, and level

with, the latter, sloping down to the ground. This temporary board, and the alighting board, are covered with a cloth hanging over the sides to the ground, to prevent the bees from crawling underneath. The skep or box is then taken between the palms of the hands, and gently carried mouth downwards, until it is just above the sloping board. With a smart jerk the bees are thrown out in front of the brood chamber, about one foot away from the entrance, when they will at once begin to take possession of their new home. It is their natural inclination to run up-hill, therefore the sloping board provides an incline up which they will immediately begin to run, and this, culminating in the hive entrance, guides them into the hive. As they run in, watch should be kept for the queen, it being a satisfaction to see her safely enter her abode. When all the bees are in, the wedges should be taken away and the front of the brood chamber gently lowered to its proper position. Not a single bee must be crushed in this operation, and any bees that are in danger should be brushed away with a feather.

Care of New Swarm.—The swarm will benefit greatly if it is fed for at least a week with warm thin syrup, made from *white* cane sugar, given in a bottle feeder. This syrup is made by adding three-quarters of a pint of water to one pound of sugar and heating it over the fire until the sugar is dissolved. It is administered by means of the bottle feeder (Fig. 3), which consists of a feeding stage having a semi-circular slot cut half-way round the tin plate, and a bottle having a cap with a series of nine holes punched in such a position that the number of holes exposed in the slot of the feeding stage for the bees to feed at when the bottle is inverted over it, is regulated by turning the index finger on the cap to the required number marked on the wooden portion of the stage. A feed hole is provided in the calico quilt by cutting a square flap, which can be turned back for placing the feeding stage in position, and replaced to prevent the escape of the bees when the feeder is not in use. The syrup should be given warm, and in the evening; access to three holes only being allowed, and a constant supply kept in the bottle for at least a week.

The bees must be kept warm by adding on the top of the calico or tick quilt about three thick quilts cut from old carpet, or other thick clean material of a similar character, or several neatly folded newspapers.

On the second day after hiving the swarm, an examination should be made to see that the foundation has remained firmly fixed in the frames. At the same time close the bees, by means of the division board, on to the number of frames of foundation they are able to cover. When these are all built out and well covered with bees (and not until) add a frame of foundation in the centre periodically, until all the frames are occupied by fully drawn out comb and bees.

Methods of obtaining Extracted and Comb Honey.—If the swarm has been obtained early in the season this building up will proceed fairly rapidly until all the combs are completed, and brood rearing will be carried out on such a scale that the hive will become overcrowded with bees before the honey flow is over. If this condition is allowed to continue the bees will swarm.

Swarming is the result of overcrowding, and can be prevented, to a great extent, by giving the bees room in advance of their requirements. This can be effected as follows:—Remove the quilts and place the zinc queen excluder (Fig. 4) in position over the brood frame tops. This excluder, which covers the whole ten frames, is perforated with slots made so accurately to size that the workers can pass through, but not the queen. The latter is thus prevented from ascending to the supers, with the result that honey without the intermingling of brood or pollen is obtained. A super should now be put on. If it is a shallow frame super as seen in Fig. 1 and 2 the frames should be fitted with full sheets of wired drone base foundation. These hang in the supers in the same manner as those in the brood chamber, but as they are for the storage of honey only, and not for brood rearing, it is not necessary to adhere to the narrow $\frac{7}{8}$ in. combs used for this purpose in the brood chamber. The bees can, and will, store honey in a deep cell, therefore a wider frame is used spaced by 2 in. metal ends so that only eight combs instead of ten will fit in the super, thus economising space, foundation, and wax cappings. The larger drone cells also permit the honey to be more expeditiously extracted than is the case with the smaller worker cells.

If it is desired to work for comb honey a section rack, as seen in Fig. 1 and 2 is used. This is a framework which holds twenty-one sections $4\frac{1}{4}$ in. square and 2 in. deep, in seven rows, three in each row, standing on slats to allow ingress and egress of the bees vertically. Each section is fitted with a full sheet of extra thin comb foundation. To prevent the bees extending the comb beyond the woodwork of the section thin metal dividers are placed between each row and following boards, wedged tight by means of spring blocks at one side and end, complete the fitted rack. These sections when filled with honey and sealed over weigh one pound each.

Individual stocks can be worked entirely for either extracted or comb honey, or a combination of the two kinds of supers may be used.

When the combs in the first super put on are drawn out, and about two-thirds of the whole are filled with honey (*i.e.*, when the bees commence to seal over the honey in the middle of the central combs), the super should be lifted and a second one placed underneath it. In this way work in advance of the requirements of the bees is provided for and swarming is prevented, as the bees will continue completing the work in

the upper super as well as proceed to build combs in the new one provided between the upper one and the brood chamber. (If the extra super is placed on the top of the occupied one, it is quite possible that instead of entering it, and commencing to work, the bees will swarm.) Another advantage is that, as the heat of the hive rises, the temperature in the top super will be higher than elsewhere, so that the ripening of the honey by the evaporation of the excessive moisture contained in the newly-stored honey in the cells will be accomplished more quickly.

When the honey flow commences to decline it is better to allow the bees to complete those supers already in situation than to give extra ones. The former procedure will procure a complete and well-matured harvest, while the latter will result in a large quantity of unfinished work, and honey of an inferior quality. It is an advantage at this stage to proceed as follows:—If there are say three supers on, all should be removed. From each super should be taken out those combs which are completed and sealed over. The remainder will probably be accommodated by one super in which they should be placed and returned to the bees for completion.

Supers are fit for final removal from the bees only when all the honey is hermetically sealed over with wax. This is not done by the bees until the honey is ripe, *i.e.*, when the excessive moisture has evaporated, and such a density obtained, that when the honey is extracted and stored it will remain sound and will not ferment.

The bees are cleared from the supers by means of an escape (Fig. 5) from which it will be seen that the bees pass through a hole into a passage-way in which there are two springs placed in a " V " shaped position. This escape is fitted into a clearing board (Fig. 6) consisting of a cleated board so made that it entirely covers the top of the brood chamber. The clearing board, with the escape in position is placed in the evening under the super or supers which it is desired to remove. The only means of exit for the bees is from the wide ends of the springs in the escape, which are so finely adjusted that the bees can push them apart to pass out at the points, but are unable to return when the springs are closed. Any attempts to return result in the springs being closed more tightly. In twelve hours or less the super or supers will be quite free from bees, and can be removed. In the case of comb honey all that is necessary is to remove the sections, clean, and store them in a dark, warm, dry and dust-proof cupboard, until required.

Extraction.—The honey in the shallow combs must be extracted as soon as it is removed from the hive, while the honey is still warm. If it is allowed to get cold it will not leave the cells so readily. If, however, a period must elapse between removal and extraction the supers should be stored in

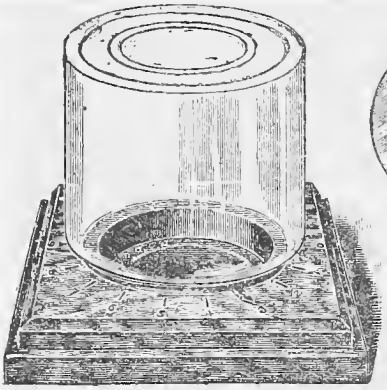

Fig. 3. Bottle Feeder.

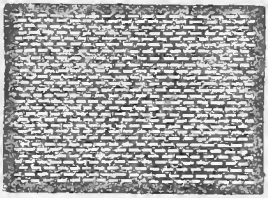

Fig. 4. Queen Excluder.

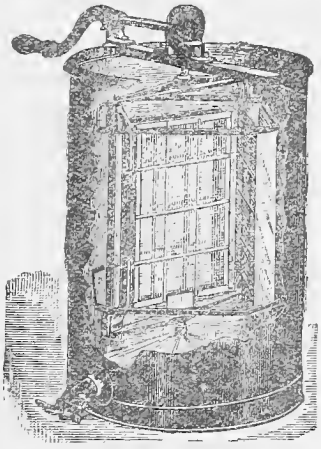

Fig. 7. Honey Extractor.

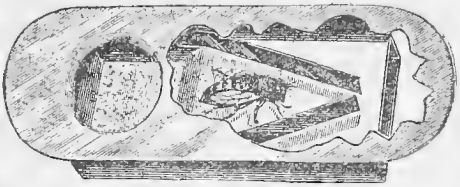

Fig. 5. Bee Escape.

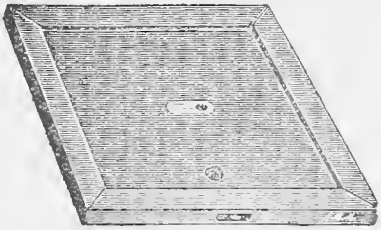

Fig. 6. Clearing Board.

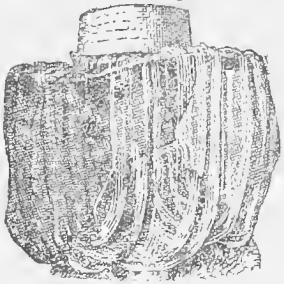

Fig. 8. Bee Veil.

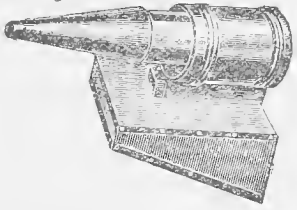

Fig. 9. Smoker.

a warm situation. Extraction is carried out by means of an extractor (Fig. 7) which consists of a tin cylinder fitted with an inside cage working on a spindle, to the top of which is attached a handle so that when the latter is turned the cage will revolve. The cage will accommodate either two standard or shallow combs, one on either side, or twelve sections, six on either side.

The first operation in extracting honey is to uncap the combs. For this purpose a special knife can be purchased, but an ordinary sharp carving knife will serve the purpose equally well. A jug, the depth of the length of the knife blade, is filled with hot water, and the knife inserted. If a cold knife is used it will tear the comb and spoil it for future use. A large meat dish will also be required to receive the cappings as they are cut off. A comb should be taken in the left hand, held by one lug, the other lug being rested on the meat dish with the comb in a vertical position. The top is then slightly inclined towards the right hand, in which the knife is held. By this means the cappings, when cut off, will fall clear of the comb and will not adhere to it, which would be the case if the comb were held quite upright. The cappings are removed by cutting upwards from the bottom of the comb with a see-saw movement. A neat operator will be able to remove all the cappings in one upward movement. Between the cappings and the honey there is an air space, so that if a thin cut is made the knife will pass through this air space, and very little honey will be left on the cappings, thus saving the considerable labour which would be involved in draining them if a thick cut is made with a consequent large amount of adhering honey.

Having removed the cappings from each side of two combs, the latter are then placed one in either side of the cage, in the pocket provided for this purpose. The cage is then turned rather slowly. The combs are heavy, and if turned rapidly at first they will break. When a portion of the honey has been extracted from one side, the combs are reversed, and the other side treated in a similar manner. After this, both sides can be extracted completely by revolving the cage more rapidly. As the cells of the comb have an upward inclination extraction can be expedited by so placing the combs in the cage, that when turned, the bottom bar leads.

When the honey in the extractor reaches to the cage, it is drained off, by means of the tap at the bottom, and passed through a muslin strainer into 28 lb. tins, or other suitable vessels.

The wet combs are now given back to the bees to clean down. To do this neatly and without inciting robbing, the clearing board is left in position over the colony, and the tin slide over the hole seen on the front side of the board is withdrawn so that the bees can pass freely up into and down out of the

super, to carry the honey from the wet combs in the super, and to store it in the brood combs. When the combs in the super are quite dry, the tin slide is pushed back over the hole, so that the only exit for the bees is through the escape. In this way the super is freed from bees, and can then be taken off and stored away ready for use the following season.

The most profitable system is to work for extracted honey. It takes from 10 to 20 lb. of honey to make one pound of beeswax, so that when a section is sold the bee-keeper parts with a valuable asset in the form of wax, the latter being consumed with the honey. Shallow combs can be used for an unlimited number of years. They are always clean, as brood rearing is not allowed to take place in them, and the longer they are used the tougher and stronger they become. It will therefore be seen that for every pound of wax in the form of comb already built which is given to the bees for filling, a considerable amount of honey is saved. An economy in the time and labour spent by the bees in comb construction is also effected.

Subduing and Handling Bees.—The chief attributes necessary for handling bees successfully, and with the minimum number of stings, are a knowledge of the habits of the bee, firm but gentle movements, adequate protection of the manipulator and proper subjugation of the bees.

The only protection necessary is a veil for the face (Fig. 8). This is made of black mosquito netting, with an elastic band both top and bottom, fitting tightly round the crown of the hat and under the collar of the coat to prevent the ingress of the bees. This gives confidence, and also prevents the disfigurement which would be caused by stings received on the face. Gloves should not be worn as they conduce to clumsiness, which will irritate the bees. Tight fitting garments to prevent the bees creeping underneath sleeves or up the trousers are also essential.

Subjugation is carried out by frightening the bees. When frightened they gorge themselves with honey, and in this condition are not inclined to sting. For this purpose one of two subjugators can be used—a smoker (Fig. 9) or a carbolic cloth. The former consists of a tin cylinder having a conical nozzle, open at the pointed end. This is fastened to a pair of bellows with a connection between the two at the back. Ordinary thick brown paper, corrugated paper, or fustian, is rolled into a cartridge, lighted, and placed in the furnace of the smoker, with the lighted end downwards. When the bellows are worked a volume of smoke is emitted from the nozzle and can be driven in any direction. A carbolic cloth is made by sprinkling a piece of calico, the size of the quilt, with a solution of one part Calvert's No. 5 carbolic acid to two parts of water. When not in use this is kept in an air-tight tin box in order that it should not lose its odour.

The smell of the smoke driven into the hive, or the fumes from the carbolic cloth which descend when it is laid over the tops of the frames after removing the quilts, frightens the bees and causes them to gorge as already stated.

When manipulating it is inadvisable to stand in front of the hive; this infuriates the bees by hindering their work, which they will resent by stinging the operator.

When handling or turning the combs, keep them vertical and not horizontal. If held horizontally in warm weather they are likely to break.

Bright warm weather should be chosen for manipulating bees, as they are then usually in a good temper. If the brood combs are exposed during cold or wet weather the larvæ will be chilled and the bees made vicious.

Continual manipulation is a mistake, and is the cause of much harm. Colonies should only be disturbed for the actual work necessary.

Conditions Conducive to Success.—It is important that the beginner should clearly understand the principles that underlie successful bee-keeping. A colony of bees consists of a fertile queen, a large number of worker-bees, and (during summer) a certain proportion of drones, together with their combs and brood. The strength of a healthy colony depends on the vigour and laying power of the queen, who is at her best in her second season, *i.e.*, a queen hatched in June, 1920, will be at her best in May, 1921, and should be replaced by a young one in 1922, by re-queening. Queens may either be purchased, or be raised by the method described in Leaflet No. 334 (*How to Increase Colonies of Bees*) included in this volume. The economy of a hive depends on: (1) the generation and keeping up of the warmth of the brood nest (by means of the heat evolved from the bodies of the clustering bees) to such a point as will stimulate the production of eggs, and enable young bees to be reared; (2) the nursing of the larvæ, and the cleansing of the cells for the queen to lay in; (3) the collection of pollen, water, and nectar for food; and (4) the building of storage combs and the collection of nectar for future supplies of honey.

The first three of these conditions must be fulfilled before the last can be begun; it is therefore only by means of a large and vigorous surplus population that a colony can gather enough stores for its future use, and provide surplus honey for the bee-keeper. The aim of the bee-keeper is to keep his colonies strong, for weak colonies are always unprofitable.

The next consideration is that the crowded condition of the hive should be secured at the right time, *i.e.*, at the honey flow. Honey is made from the nectar of flowers. Spring and early summer are the times when the land is gay with a wealth of blossom, and the honey-crop is gathered. Late summer and autumn are times of seed and fruit, and with the

exception of the heather only a gleaning of nectar from bramble and other wild flowers then remains. There is a period every year, varying in each district according to soil and altitude, when the supply of nectar is most abundant. This time should be ascertained by the bee-keeper, who will then stimulate his colonies beforehand, so that they may have their largest population ready to gather the produce of the various flowers when at the zenith of their bloom.

METHODS OF OBTAINING STRONG COLONIES OF BEES FOR WINTERING.

Many bee-keepers make the mistake of attempting to winter the colonies they have obtained by artificial increase, and also other colonies that for various reasons have become reduced in numbers, in such a weak condition that they often do not survive the cold weather or the long confinement in the hive during the winter.

In order to avoid failure from this cause increase should be made early in the season, so that by the end of July at least four combs are filled with brood and well covered by bees. The colonies must then be built up during August and September until they are sufficiently strong to winter successfully.

Union of Weak Colonies.—Colonies covering less than four combs at the end of July should be united to form stronger ones. After selecting two or more weak colonies for union, move them gradually together, not more than a yard daily, and only in the evening of fine days when the bees have been flying, until they are side by side and almost touching. Allow them to remain two days in this position and then in the evening of the second day unite them in one hive. This is carried out as follows:—First, remove all the combs in each colony not covered with bees, then, after selecting and caging the best queen on a comb in the permanent hive, remove the other queen or queens. Then, after all the bees have been well dusted with ordinary wheaten flour place the combs in the permanent hive taking care to inter-space them. The empty hive or hives are then removed. The operation is completed by releasing the caged queen forty-eight hours after the colonies have been united.

Addition of Frames.—The process of building up is carried out by the gradual addition of frames fitted with full sheets of wired worker base foundation so that the bees can build them out into combs and fill them with brood and food, and in this way increase the strength of the colonies.

The frames of foundation must be added one at a time, and should be inserted in the centre of the brood nest. Another new frame of foundation should be inserted as soon as the previous one has been drawn out into comb which is not only filled with brood but is also well covered with bees; several new frames of foundation should never be inserted at one operation.

If the apiary contains established stocks of bees, combs of brood may be taken from these and given to weak colonies, thus ensuring more rapid "building up." Only combs containing good-sized patches of *sealed brood* should be taken, for, if unsealed brood is given, the strength of the bees in the weak colony is overtaxed by the extra labour expended in feeding the larvæ and in keeping the extra space warm. Not more than two combs of brood should be taken during the season from any one colony, and then, only one at a time, at an interval of at least a fortnight between the removal of the first and second combs.

The combs of brood must be given to weak colonies one at a time and inserted in a similar way to new frames of foundation, *i.e.*, in the centre of the brood nest.

It is not absolutely necessary to have the full complement of ten combs in the hive, as the bees will winter quite safely on eight. In fact, it is much better to winter the colonies on eight combs well filled with food than on ten which are only partially completed.

Temperature of the Hive.—The temperature of the hive must be maintained at about 98 deg. F., not only to enable the bees to secrete wax and ripen the food, but also for brood-rearing. The bees generate heat to a large extent by the movement of various parts of their anatomy as well as by the normal means of respiration and the combustion of food in their bodies. Thus, if they occupy too large a space, the temperature of the hive can only be maintained at the expense of energy required for comb-building, nectar-gathering and brood-rearing. Also, too much room often results in the combs being drawn out very irregularly, or else in bulges, owing to the extent to which the working capacity of the bees is taxed.

A nucleus, when formed, is usually placed in a nucleus hive or temporary box, but as soon as it consists of four combs well covered with bees, it should be transferred to a full-sized hive, and the bees crowded together on the combs by means of a division board, until after the gradual addition of frames of foundation, eight or ten combs are in use. A full-sized hive may be used from the commencement if so desired. It is only necessary to use a division board to contract the space to the requirements of the nucleus.

Feeding to increase Brood-Rearing.—In most districts few nectar-yielding flowers are in bloom after July onward, and

only a small quantity of natural food can, therefore, be collected by the bees; in any case the supply is not sufficient to yield a surplus after the daily needs of the bees have been furnished. It is most necessary, therefore, in such districts, to supplement the natural food supply by feeding with syrup to induce the colony to continue building out more combs and rapid brood-raising. This syrup must always be fed at this time of the year through a slow feeder, giving just sufficient for the purpose, otherwise, if a rapid feeder is used, the bees will store the surplus syrup in the cells which have been drawn out recently, instead of using them for the rearing of brood.

A " Regulation Bottle Feeder " should be used, if available, access being confined to not more than three holes. The bottle should be refilled before it becomes quite empty.

Making Syrup.—Syrup for feeding can be made from ordinary *white* loaf or granulated cane sugar by dissolving each pound of sugar in half a pint of water by heating over the fire; *on no account should brown sugar be used.* It is advisable to medicate the syrup with a strong antiseptic. Izal, Bacterol, or Flavine may be used for this purpose in the following proportions:—One teaspoonful of Izal to every eight pounds of sugar, one teaspoonful of Bacterol to each pound of sugar, and one grain of Flavine to each pound of sugar.

To prevent Robbing.—In order to prevent robbing, the entrance to the hives must not be wider than half an inch during the whole of the time feeding is taking place, and the syrup, which should be warmed, must be given late in the evening.

Feeding for Winter Storage.—Towards the end of September rapid brood-rearing will cease, and the syrup should then be fed more rapidly, so that the cells not required for brood-rearing may be filled with food and sealed over before the cold winter weather sets in. All the nine holes of the " Regulation Feeding Bottle " should then be exposed to the bees.

Feeding Candy.—If there is the slightest doubt that the supply of food contained in the combs is sufficient to carry the bees through to the following Spring, a cake of candy should be placed over the brood nest when packing down for winter. The candy supply should be renewed from time to time if required. The entrance to the hive should remain open about five inches throughout the winter.

Candy can be prepared as follows:—

In a clean pan, for preference of brass as used for preserving, there should be placed 3 lb. of best white loaf or granulated cane sugar, half a pint of water, and as much cream

of tartar as can be heaped on a sixpenny piece. The pan should be stood *beside* the fire, stirred occasionally until the sugar is dissolved, and then placed *on* the fire and stirred continuously until the mass boils. When it has been boiling for about two minutes, the pan should be removed from the fire and stood in a vessel containing cold water, until the sugar begins to cloud. The mixture should then be stirred well and poured into prepared glass-topped boxes made by glazing one side of a section or into saucers lined with paper, so that when cold the candy can be lifted out in a block. When set, it should be a moist solid mass easily cut into with the finger nail.

A candy-making thermometer is now made which renders this hitherto somewhat difficult task so simple that a child can make perfect candy. The bulb of the thermometer is plunged in to the centre and not to the bottom of the sugar and water which is boiled until the mercury in the thermometer rises to the top mark, when the pan is at once removed from the fire, and allowed to stand until the mercury falls to the lower mark. The thermometer is then removed, and the candy stirred briskly until it becomes stiff and assumes the well-known white appearance, when it is poured into moulds. There are only the two marks on the thermometer so that no mistake can be made.

Candy given in January should contain pea-flour in the proportion of ¼ lb. pea-flour to 3 lb. sugar. The pea-flour should be mixed during the cooling process, when it should not be poured in all at once, but should be lightly sprinkled in whilst stirring, so that it mixes evenly right through the candy.

To medicate candy when dealing with Foul Brood, to each pound of sugar should be added as much Napthol Beta as can be heaped on a threepenny piece. This should be dissolved in sweet spirit of nitre, whisky, or methylated spirit, and added when the candy is cooling, not when it is hot.

Late Swarms.—Late swarms can be built up and strengthened in a similar manner with equal success. The swarms should first be hived on to ten frames of foundation, but after about three days in the full hive they should be "closed up," and the bees crowded together by means of a division board, until all the frames of foundation are well covered with bees. The surplus frames of foundation should then be removed and feeding to obtain rapid brood-raising should commence.

HOW TO INCREASE COLONIES OF BEES.

Introduction.—Natural swarms should be prevented from issuing, so far as possible, as in many cases they are lost, and, even if safely hived, their formation not only interferes with nectar collection at the height of the season, but weakens the parent colony to such an extent that its value for producing surplus honey is reduced to very low limits.

Under these circumstances every endeavour should be made to increase colonies artificially. New colonies formed artificially early in the season have every chance of becoming strong and active honey producers; besides which, the strength of the parent colonies is reduced sufficiently to prevent them swarming naturally, but not to an extent which will interfere with their honey production.

Preparation for Increase.—Colonies must be carefully nursed to bring them to full strength early in the season. Those requiring food should be given sufficient quantities of syrup to induce the queen to lay more eggs than would be the case if the bees were dependent upon the meagre supply of nectar obtained from the few flowers in bloom at the time. If a superabundance of syrup is given, the unconsumed portion is at once stored in the cells required for brood rearing, and as a result the development of the colony is retarded.

Colonies having an abundance of stored food should not be fed with syrup, but brood production may be stimulated by bruising the cappings covering the food situated nearest to the brood nest. At the end of February, drinking water, to each pint of which is added one teaspoonful of salt, should be provided in a shallow vessel containing stones, to support the bees while drinking and to prevent them drowning. The water should be at least twelve feet away, further if possible, from the hives, and should have a shade board fixed about eighteen inches above it to prevent the flying bees soiling it with their excreta. Artificial pollen should also be supplied by scattering pea flour on shavings or chopped hay in a box placed in a position sheltered from the rain but accessible to the bees. To assist the bees to increase their number rapidly, they must be crowded together and given no more combs than they can cover thickly. This crowding is attained by means of the division board, but as the strength of the colony increases, other combs should be added, singly, as required.

Before dealing with the general methods of artificial increase, three points must be made clear:—(1) Bees locate the position of their home and not the hive to which they belong; thus, if a stock is removed to a new position and is replaced by another hive, those bees on the wing return to the new hive in the original position. (2) Natural swarms are made up of the oldest bees of the colony together with the old queen.

(3) Only strong colonies, *i.e.*, those in which the bees are densely covering ten combs, must be utilized as the basis for artificial increase, and obviously only colonies free from any disease must be used.

Methods of Increase.—1. *Formation of a Nucleus.*—As soon as warm weather sets in permanently, one nucleus can be made from each strong colony in the following manner. Open the hive about midday, when the old bees are away foraging, and remove two combs of brood and two of food, together with the adhering young bees, replacing them with four frames filled with full sheets of wired worker base foundation. It is necessary to have about a quart of bees, and if this number is not present on the three combs removed, the requisite number may be obtained by shaking the bees from two or three other combs, from the parent colony into the nucleus. Great care must be taken not to remove the queen with these combs. The two outer combs of the parent colony usually contain the most food and should therefore be selected for use in the nucleus. The combs containing the brood must be placed together between these in the new hive for greater warmth. Close up with the division board and wrap up warmly, and confine the bees in the hive for 48 hours by lightly plugging the entrance with dry grass. During bad weather give a little syrup. The bees in the nucleus upon discovering that they are queenless will rear a queen. If a fertile queen, virgin queen or a ripe queen cell is available one or other should be given; this will enable the nucleus to build up much more rapidly. With care this nucleus can be built up into a colony strong enough to winter successfully.

2. *Increasing the Strength of the Nucleus (generally termed Nucleus Swarming).*—When the queen in a nucleus formed in the manner mentioned in method 1 has been mated and commenced to lay, open the hive on a fine morning, find the queen and cage her on a comb. When this is accomplished, fill up the hive containing the nucleus with either drawn-out combs or frames fitted with full sheets of wired worker base foundation to its full complement of ten. Transpose a strong stock with that of the nucleus. As previously explained, bees only locate the position of their hive, and not the hive itself. Thus the bees out foraging from the strong stock will return to the nucleus and *vice versa*. As a result the hive containing the nucleus will become fully populated and sufficient young bees will be left in the old colony to enable it to recover strength rapidly. The queen caged in the nucleus is released after being confined for forty-eight hours.

About a fortnight after this operation has been carried out each stock will be sufficiently strong to receive a super if favourable conditions have prevailed.

Artificial increase by the combination of methods 1 and 2 is strongly recommended as producing the best results, owing

to the fact that at no period when the colonies are strong are they queenless.

3. *Making one Extra Colony by Utilizing a Number of Others.*—In this method the increase is obtained by utilising several strong colonies of bees. An example showing the utilization of three colonies may be given:—From two of the colonies remove three combs of brood without the adhering bees, and replace them with frames fitted with full sheets of wired worker base foundation. The six combs of brood, thus obtained, should then be placed in the centre of a fresh hive, with a couple of frames fitted with full sheets of wired worker base foundation on either side, thus making the number of frames up to ten. The third colony, from which no brood has been removed, is moved to a new site, and is replaced by the hive containing the brood combs, which is then populated by the flying bees from the stock that has been removed to a new site. These bees will rear a queen from the eggs in the combs. If, as stated in method 1, a fertile or virgin queen or ripe queen cell can be given, it will be a great advantage.

This principle can be applied to a larger number of colonies by taking fewer brood combs from each, always arranging for one colony from which no brood combs have been taken to supply the bees. The parent colonies used in forming the nucleus will be reduced in strength sufficiently to prevent them, in the majority of cases, from swarming naturally, and, provided care is exercised, will not be weakened to such a degree that honey production is decreased to any great extent.

4. *Formation of an Artificial Swarm.*—This is made in the following manner. Open the hive containing the selected colony about ten o'clock on the morning of a fine day. Search for the queen and when found, place the comb on which she is, together with the adhering bees, in a fresh hive in the centre of nine frames fitted with full sheets of wired worker base foundation. Remove the parent stock to a new site and stand the fresh hive in its place; the bees from the parent stock which are out collecting nectar will, as in the other cases mentioned, return to this hive and so found a new colony. The young bees left in the parent stock will rear a queen, or a fertile or virgin queen or ripe queen cell can be given with advantage.

5. *To obtain surplus Honey and yet retain increase of stock in the case of a colony swarming naturally.*—When, in spite of all precautions, a colony having a super or supers on it throws off a natural swarm, first hive the swarm into a temporary home (box or skep), then remove the parent stock to a new site, replacing it with a fresh hive containing ten frames fitted with full sheets of wired worker base foundation. Remove the supers, with their occupants, from the parent stock and place them over the frames in the new hive. Then

run the swarm into this "supered" hive in the usual way. By this method, two strong colonies will be obtained, and, as all the foraging bees from the parent stock will join the swarm hived on the old location, the population will be increased sufficiently to enable them to complete the work of filling the supers.

6. *Casts or Second Swarms.*—Should it so happen that a cast issues from a colony after it has swarmed naturally, provided it is known from which colony it issued, it should be returned. For, although casts can be built up strong enough to winter successfully, their departure reduces the population of the parent colony to a dangerous degree.

Casts should be returned in the same manner that a swarm is hived on the second evening after the day of issue.

If more than one cast issues at the same time, and it is not known from which colonies they came, they should be united so as to form one strong colony. This is accomplished by hiving them at the same time into their permanent homes. The excitement caused by throwing them on to the hiving board together causes them to intermingle without fighting and obviates the necessity for using flour.

Production of Queen Cells.—Queen cells can be produced ready for insertion into the nuclei twenty-four hours after they have been made, in the following manner:—

Select two colonies the previous season, one for rearing queens and the other for rearing drones. In doing this it should be borne in mind that constitution and working qualities are transmitted by the queen, while disposition is transmitted by the drone, therefore, the one chosen for drone rearing should not only have the qualities required for queen rearing but in addition should be good-tempered.

Both colonies must be stimulated so that they become strong early in the season, when both lots are covering ten combs. Insert into the centre of the drone-rearing colony a comb consisting of drone cells or a frame fitted with drone base foundation. In this way early selected drones can be secured.

A fortnight later insert into the centre of the queen-rearing colony a frame fitted with an unwired sheet of worker base foundation. When this sheet has been built out into comb and the cells contain eggs, make it queenless by removing three combs with the queen and adhering bees, placing them in a separate hive close to the parent stock.

Twenty-four hours after the colony has been made queenless cut away a strip two inches deep from the bottom of the unwired comb. Break down the walls of the worker cells and expose the eggs round the freshly-cut edge at intervals of $1\frac{1}{2}$ inches, so that the queen cells which are built round them can easily be removed. The queen cells can be cut out and placed in queenless nuclei as soon as they are sealed over. The original queen belonging to the colony used for queen

rearing is reintroduced to the colony as soon as the series of queen cells have been removed from the comb on which they have been built. Other series of queen cells can be obtained by repeating the process.

Note.—Care must be exercised to make the production of queen cells coincide with the formation of nuclei suitable for their reception.

BEESWAX.

Wax is not *gathered* by the worker bee, but is organically produced in her body from honey and pollen, by secretion. It is formed voluntarily by the bees filling their stomachs with honey, hanging in the hive in chain-like clusters, and remaining perfectly quiet for twenty-four hours. A good deal of pollen is consumed to make up for the wear and tear of tissue during wax secretion. During this period the wax glands convert the honey taken into their bodies into liquid wax, which exudes through tiny perforations into eight small pockets, or moulds, situated on the underside of the last four abdominal segments, where it hardens into small white scales (Fig. 1). It is then plucked out, made plastic by the admixture of saliva, and utilised for the building of the comb, the hermetic sealing of honey cells, and, with the addition of pollen, for the porous sealing of brood cells. It is computed that from 10 to 20 lb. of honey are required to make 1 lb. of wax. The work of wax secretion tells severely upon the vital powers of the bee, and as wax is a valuable and costly product, none of it should be wasted.

How to Collect Wax.—When cleaning hives or appliances, a box should be kept for the collection of all refuse and burr combs. The scrapings from the floor board, which are generally thrown on the ground during spring cleaning, should be saved, although they contain a quantity of dirt and propolis, for there is generally sufficient wax to make it worth the trouble of collection and extraction. The honey combs used for extracting do not wear out, but last indefinitely; brood combs, on the contrary, become thickened by the cocoons and cast skins of the moulting larvæ, and must be continually renewed. Wax can therefore be obtained from old brood combs and the cappings from extracting combs.

Methods of Extraction.—The extraction of the wax may be made by using: (1) The Solar Wax Extractor; (2) steam; (3) boiling water; or (4) the heat of the oven.

The Solar Wax Extractor is the most efficient and economical method. The cost of the extractor is the only expense incurred, as the sun provides the necessary heat. The appliance is really a miniature garden frame, with a double glazed and hinged light (Fig. 2). Inside, the frame is fitted with a metal tray which slopes down to a tin trough covered with wire gauze. The extractor is placed in a sunny position and the material to be treated is spread thinly over the bottom of the metal tray. The wax melts and runs into the trough, being strained of impurities by the wire gauze covering. When the melted wax ceases to flow, the dross remaining in the tray is removed and a fresh supply of material given. Another advantage of this extractor is that no storage of old combs or refuse is necessary; these can be put in for treatment as collected.

If a garden frame is available, it can be used for extracting wax by placing the material to be treated in a perforated zinc tray over a metal box (such, for instance, as a biscuit tin), placed close up to the glass light. Wax extracted by solar heat improves in colour instead of deteriorating, as it may do when steam or boiling water is used.

Steam.—The material to be extracted by methods (2) and (3) must be stored until required in an air-tight tin, for protection against the ravages of the wax moth. In the winter it can be melted over the kitchen fire by means of a Gerster wax extractor (Fig. 3).

This is an arrangement similar to a domestic steamer, as illustrated in Fig. 3. It consists of a cylindrical, perforated, tin basket (A), having a cone-shaped tube running up the centre (*c*), which is also perforated, and open at the top to allow the steam to percolate right through the combs or wax that are placed in it for melting. The upper part of the appliance (B) consists of a circular shaped pan, having a false bottom or tray (tr.) about 1½ in. deep. This is fixed so that there is a space between it and the wall of the pan, in order that the steam can pass up the sides and into the perforated basket, as indicated by the arrows.

From this tray the melted wax passes through a tube (indicated in the drawing by the word "*wax*"). There is also a cone-shaped tube (st.) running up from the tray, which fits very loosely into a similar perforated tube (*c*) in the basket. When placed in position, as shown in section at B, this is open at the top to allow the steam to pass through as indicated by the arrows, and thus permeate the wax or combs in the basket. The basket does not fit close down on the tray, but is raised about 1 in. on three legs. The bottom pan is for water only

The method of working is as follows :—The perforated basket is filled with comb which has first been broken into small pieces; these should not be pressed down, but put in as loosely as possible The basket is placed in position in pan B, and covered with the lid (l). Pan B is now fitted on pan (*c*), which has previously been filled with rain water. The appliance is then put on the fire, and when the water boils the steam will pass in the directions indicated and will melt the wax from the combs in the perforated basket. The molten wax will ooze out through the perforations, run down the sides of the basket into the tray, and thence out of the tube, where it drops into cold rain water, contained in a vessel (D) placed for the purpose of receiving it. As soon as it is cold, the wax will be found to have

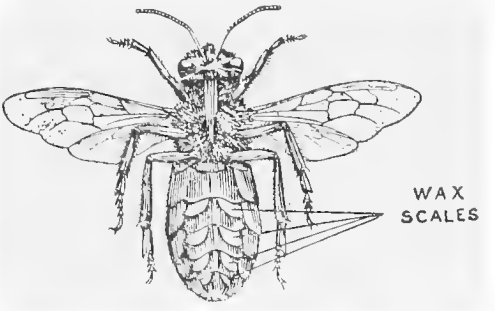

FIG. 1.—Drawing of Worker Bee, showing Wax Scales.

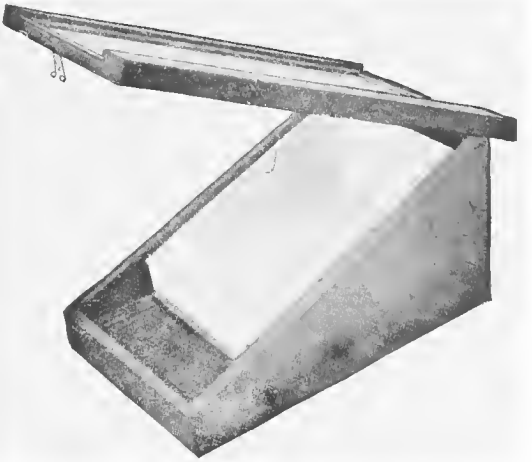

FIG. 2.—Solar Wax Extractor.

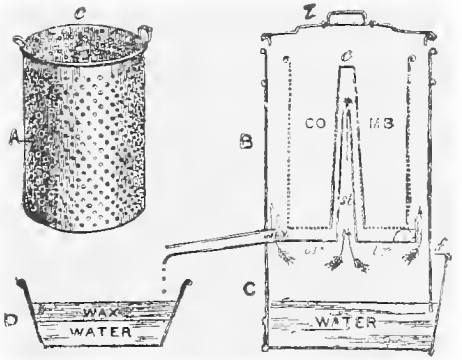

FIG. 3.—Gerster Wax Extractor

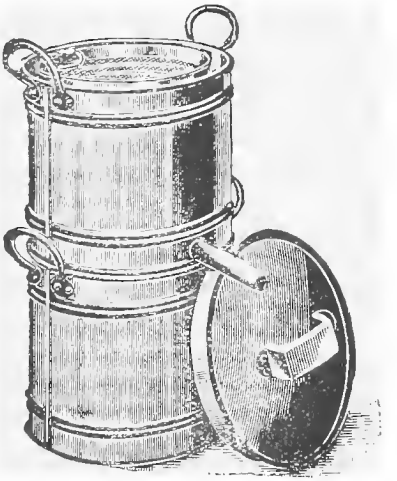

FIG. 4.—Cottager Wax Extractor.

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set in a cake, when it can be lifted off. When all the wax has been extracted the dross is removed from the basket and the process repeated. As the water boils away very rapidly it will be necessary to replace it from time to time; by means of the funnel (*f*) this can be done without removing the appliance from the fire.

Cappings from the shallow combs, when cut off for extracting the honey, can also be melted in the same manner. Before putting them in the basket, however, they should be drained free from honey, well washed in rain water, and dried in the sun.

A cheaper form of wax extractor is shown in Fig. 4. This is made on similar lines to the Gerster, but the cost is reduced by omitting the central cone-shaped tube; in all other respects it is identical. As steam is not admitted into the centre of the perforated wire basket, the operation of extraction is prolonged.

Boiling Water.—To extract wax by means of boiling water, the material should be tied in a bag made of porous fabric, such as cheese straining cloth, and stood on laths of wood placed across the bottom of a copper or saucepan, so that the bag does not touch the bottom. The bag should be weighted with a stone, and water then poured in until it flows above the bag. The water should then be boiled very gently. The melted wax will percolate through the bag and float on the water, and when cold it can be lifted off in a solid cake. A little dross will be found on the bottom of the cake, but this can be removed by scraping. If a well-cleansed sample is desired, the cake should be remelted in a similar manner, and cooled slowly. Rain water must be used in methods 2 and 3, as hard water contains lime, which would spoil the texture and colour of the wax. More wax will be obtained if pressure is applied to the bag while boiling, and in the case of old combs, if these are well soaked in water previously to melting.

The Heat of the Oven.—If only a small quantity of wax is to be dealt with, it may be placed on a piece of perforated zinc over a bowl of rain water, and put in the oven. The wax will melt and drop through the perforated zinc into the water; the impurities will remain on the zinc and can be thrown away. The bowl is then taken out of the oven and the water and wax allowed to cool, when the latter will have set in a cake and can be lifted off.

Characteristics of Pure Wax.—The melting point of pure beeswax is between 63° and 64° C., which is higher than that of any other wax. The colour, which varies from pale primrose to orange red, depends to a great extent upon the variety of pollen consumed by the bees. It is a curious fact that dark honey produces a light wax, while light honey yields one of a darker hue.

For commercial purposes the lightest coloured wax commands the best price, and therefore, before extracting,

it is advisable to grade the combs. Those which have not been occupied by brood, and also cappings removed from combs previous to extracting the honey, will yield the best wax, and should be sorted out and melted separately from old combs, which will yield a darker and consequently less valuable wax.

Adulteration.—The following are simple tests for detecting adulteration of beeswax:—

(1) A small piece of wax placed in the mouth and chewed should not adhere to the teeth, or become pasty, but, generally speaking, should disintegrate into small fragments, and have no unpleasant taste.

(2) Place a piece of suspected wax (of the size of a small nut) into a test tube, half fill with spirits of turpentine, and carefully warm over the flame of a spirit lamp. If the solution is cloudy, or a deposit is thrown down, the solution is not complete, and the wax is adulterated, as spirits of turpentine completely dissolves pure beeswax.

THE PREPARATION AND PACKING OF HONEY FOR MARKET.

Qualities of Honey.—The honey classes which are now a common feature of agricultural and horticultural shows, have taught the consumer the value of first-class home-produced honey; therefore, to obtain the best prices for their produce, beekeepers must pay careful attention to grading and packing. Comb-honey should be translucent, showing the clear bright colour of the contained honey, the combs should be fully worked out to the sides and bottom of the section, and scrupulously clean, the cappings should be thin and of even surface. The finest liquid extracted honey is bright and clear, of a light amber colour, and delicate in flavour and aroma. Extracted honey when granulated should be of fine, even grain, creamy white in colour, and of good flavour. There are many grades of medium and dark-coloured honeys which fail to reach this standard but which are of excellent quality in flavour and aroma, and in some localities these honeys will sell more readily than the lighter samples. Colour is only a matter of fancy and does not affect the eating qualities. For instance, heather honey commands the highest price of all. It is in a class by itself, dark amber in colour, gelatinous in consistency, redolent of the moors in both aroma and flavour.

Preparation for Obtaining Comb-Honey in Sections.—In the case of comb-honey, the preparation commences with the fitting of the wax foundation in the sections. To ensure a well worked out section this should be cut so as just to fit

in the grooves at either side and to hang to within one-quarter of an inch of the bottom, thus allowing for a slight stretching of the foundation caused by the heat generated by the bees when clustering in the hive. The fitted sections must next be placed in the section rack, with separators between the rows, reaching to within three-eighths of an inch of the top and bottom, and wedged up perfectly square and tight; this is important, for not only will the bees place *propolis* in every crack and over every exposed small surface, causing disfigurement and extra work in cleaning the sections when completed, but also sections " out of squsre " are difficult to glaze and are much more liable to breakage when packed for travelling, owing to the unavoidable spaces caused by their irregularity. The rack must be placed perfectly level over a strong colony of bees, and should be well covered with warm material to exclude the smallest draught and conserve the heat; the sections will then be filled with good, straight and even combs.

Removing Completed Racks.—Racks containing completed sections should be removed from the hives with as little disturbance to the bees as possible; undue excitement will cause the bees to perforate the cappings covering the honey to such an extent as to make them unsaleable. The best method is (1) to place a " super-clearer " on a stool or box by the side of the hive, raise up the bottom edge of the rack from the brood chamber or under super by means of a screwdriver, or a similar tool, and insert a small wedge of wood underneath the rack; (2) puff a little smoke between the rack and the top of the under chamber, remove the rack steadily with a screwing motion and put it down gently on the " super-clearer "; (3) place a cloth on which a few drops of diluted carbolic acid have been sprinkled over the top of the under chamber; (4) in about ten seconds remove the cloth, and it will be found that the bees have been driven down, leaving the top of the under chamber free from crawling bees; (5) then immediately take up the rack with the " super clearer " and place it back in its original position. If this operation is carried out in the afterncon, by next morning every bee will have found its way down to the body of the hive through the bee-escape in the centre of the " super-clearer," and the rack can be removed with comfort to the bee-keeper and without disturbance to the apiary.

The racks of completed sections should be carried into a bee-proof room, and the spring blocks and following boards removed. No matter how much care has been exercised, it will be found that the bees have used a certain amount of propolis to fasten the sections together and it will be necessary therefore to loosen them by inserting a knife and easing them sideways, when they can be lifted out without damage. The sections should then be sorted, those which are well filled and

sealed and light in colour being placed in the first grade. Those not so well worked to the bottom and sides or which are dark in colour, will make a second grade, while any only partially filled must be given back to the bees to finish, unless the " honey flow " has ceased, in which case they must be emptied by the extractor.* All propolis must be scraped carefully from the woodwork of the sections, which, if not already sold, should be protected from dust by tying them in packages of four or six in clean paper and storing them in a dry, warm, dark cupboard. Care must be taken not to place any material having a strong odour near a honeycomb, or it will spoil the flavour of the honey.

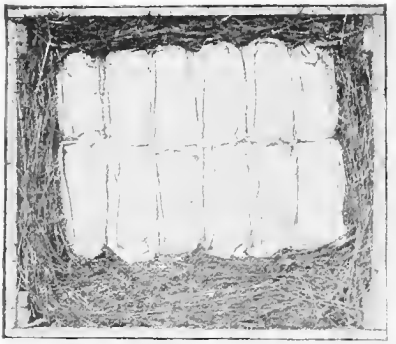
Packing Sections.—If the sections are sold to wholesale dealers no further preparation is needed. To pack them so as to travel safely, not more than three dozen should be put into one package.

A satisfactory method of packing is as follows:—(1) Procure a strong wooden box, bore two holes in each end, about one-third down, and knot firmly into them rope handles by which the box can be safely and easily lifted; (2) put a deep bed of straw in the bottom of the box and on this place, quite close together, a layer of the wrapped-up packages of sections, leaving at least two inches between the sides of the box and the sections: this space must be filled with straw, tightly pressed in, and, to prevent possible damage to the comb, the ends of the packages must be protected by pieces of cardboard or thin wood; (3) continue with layers of packages, filling in round the sides as before until within about two inches of the top; (4) then fill up tightly with straw, and *screw* on the lid. Fig. 2 shows the method of packing three dozen sections in a Tate cube sugar box. The sections are tied in packages of six. One side of the box has been removed to show the sections and straw in position. The bottom bed of straw should be very deep to prevent the sections being jarred when the box is set down. For small consignments of one dozen sections it is better to use a spring travelling crate (Fig. 4). Packages should be plainly labelled: " Comb-honey, With Great Care."

Retailers of honey-comb prefer to have the sections sent to them glazed, the comb being thus preserved from injury by careless handling, and, which is still more important, kept free from the dusty impurities unavoidably present in shops.

Glazing the Sections.—For glazing sections, glass cut to the correct size may be purchased from any dealer in bee appliances, together with the strips of lace paper edging, which, when pasted round the angle formed by the glass and wood, serve to fix the glass in position. In country towns the local glazier will gladly cut up waste glass to the small size

* *See* Leaflet No. 128 (*Advice to Beginners in Beekeeping*) included in this volume.



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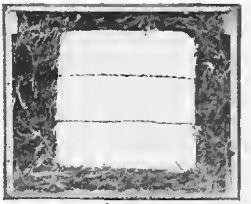

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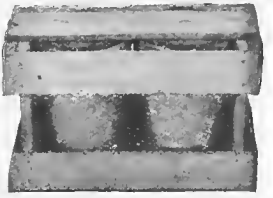

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FIG. 1.—Jars packed in a Tate's cube sugar box. The side of box has been removed to show jars in situation.

FIG. 2.—3 doz. sections packed in a Tate's cube sugar box. The side of box has been removed to show packages in situation.

FIG. 3.—Crate holding two 28 lb. lever-top tins.

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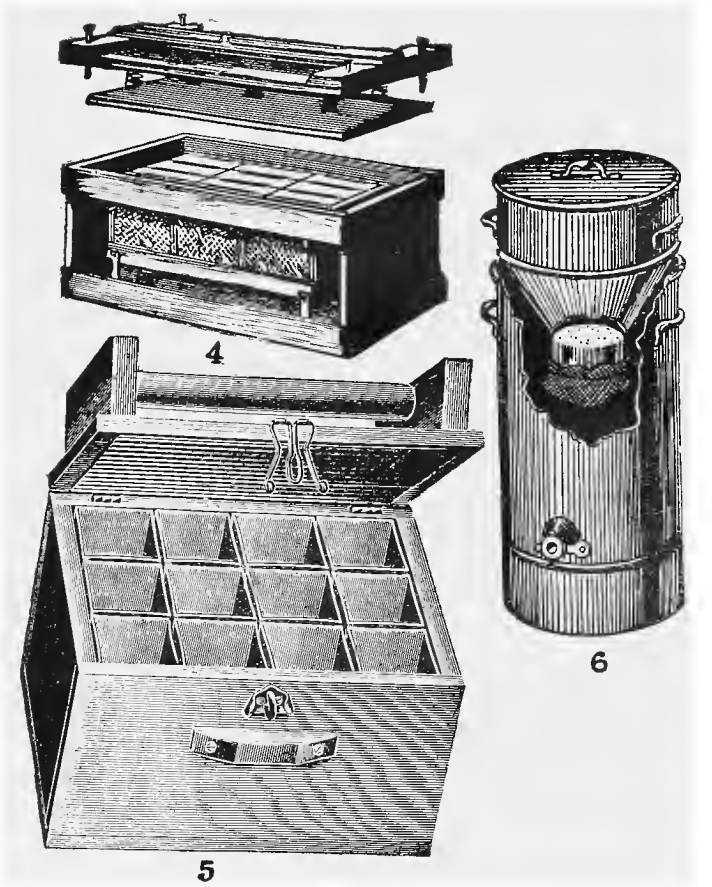


Fig. 4.--Cowan Travelling Section Crate.

Fig. 5.—Spring bottom box for 1 doz. jars.

Fig. 6.—Honey Ripeners with strainer in situation.

(*viz.*, 4 $\frac{3}{16}$ in. by 4 $\frac{3}{16}$ in.) required, while neatly printed bands of coloured paper, 19 in. by 3 in., may be used instead of the lace edging. They are more easily pasted on than the loose paper edging, and they also give an opportunity of placing the names of the apiary and producer on each section. Neat cardboard cases, plain or glazed on one or both sides, can be purchased cheaply from appliance manufacturers.

Extracted Honey.—"Extracted" honey has been greatly improved in quality by the introduction of modern methods. The use of the centrifugal extractor compels the abandonment of the skep system of bee-keeping, with its waste of bee life, waste of combs, and taint of sulphur. It necessitates the adoption of the moveable comb hive, which enables the gathered surplus to be stored in combs apart from the brood-nest and to be removed at will by the bee-keeper.

Honey improves in flavour and density while ripening in the hive, therefore the shallow comb supers should be left until the honey is well sealed over before being removed by the super-cleaner in the same manner as already described for the removal of section racks. The supers containing the full frames of sealed comb having been carried into the store-room, they should be graded by holding them up to the light: all those containing dark or medium coloured honey may thus be separated from those containing light honey. Fermentation is the great enemy of extracted honey, but it can only affect badly ripened honey or honey exposed to moisture and warmth; if, therefore, it should be necessary to extract unripe honey, *i.e.*, honey which has not been sealed over, it should be fed back to the bees for re-storing and ripening.

The method of extracting honey is described in Leaflet No. 128 (*Advice to Beginners in Bee-keeping*) included in this volume. Heather honey cannot be extracted by centrifugal force, on account of its gelatinous nature. Therefore it is necessary to put the combs through a press to squeeze out the honey.

Packing Extracted Honey.—After uncapping and extracting the honey it should be strained through a bag made of muslin in order to remove all loose particles of wax. Tin vessels, called honey ripeners (Fig. 6), with strainer and honey tap, made to contain 56 lb. or 112 lb., can be obtained, in which, if the honey is allowed to stand for twenty-four hours after straining, it will be freed from air bubbles, and can then be drawn into whatever jar or tin will best suit the local market. For the retail trade extracted honey is usually put into 1 lb. or $\frac{1}{2}$ lb. glass jars, with metal screw caps having a cork wad inside the cap. To prevent any leakage the cork wad should be dipped in molten wax and placed on the jar while still warm, the cap being screwed down upon it. A neat label (of which varieties are obtainable from appliance makers

or from the Secretaries of many of the County and District Bee-Keepers' Associations) will set off the honey jar and make it more attractive. The darker honey is more suitable for marketing in its granulated state; when extracted and strained it should be run into wide-mouthed glass or earthenware jars, covered down with parchment paper, and stored in a cool, dry place. Dark and coarse-flavoured varieties may also be sold for manufacturing confectionery and for medicinal purposes, or for the making of mead and honey vinegar.

For transit the same kind of box as that used for sections can be used. Each jar should be well wrapped in newspaper and then packed as illustrated (Fig. 1.) For an odd dozen a box with square cardboard containers and a spring bottom (Fig. 5) can be used.

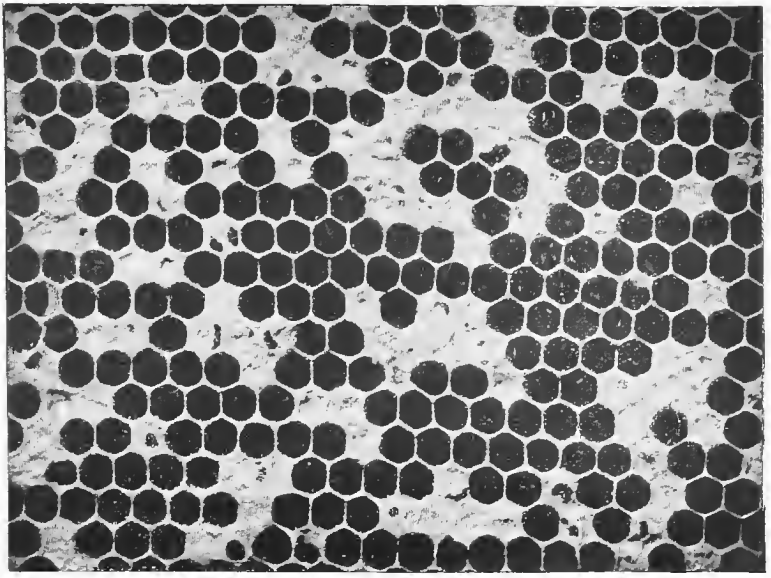
Honey designed for sale in bulk should be put into 28 lb. lever top tins. For transit cases to hold two of these tins are made (Fig. 3). These are convenient to handle and simplify the making up of any consignment from ¼ cwt. to tons. If a family trade is cultivated, 7 or 14 lb. lever top tins can be used.

FOUL BROOD.

Description.—Foul brood is a disease affecting bees which spreads so rapidly by contagion that, in a single season, unless precautions are taken, the colonies in a whole neighbourhood may become affected, and the chances of successful bee-keeping therein will be seriously imperilled, if not utterly destroyed.

Two forms of foul brood have long been known to exist in Europe, a virulent or strong smelling, and an odourless form. A third type has recently been added; this is called *Sour brood*, and it has usually been found associated with the strong smelling type. In the first two forms of foul brood, microscopic rod-shaped bacilli are present; these bacilli increase by cross-division, and have, under certain conditions, the power of forming spores. It is important to note that bacilli are present in the earlier stages of the disease, but in the later stages, when the brood has become rotten and coffee-coloured, or has dried up to a scale, the bacilli produce spores and then perish. These spores represent the seeds of the evil; they constitute a resting resistant stage tiding the bacterium over unfavourable conditions, and are capable on the return to favourable conditions as regards food, temperature, &c., of giving rise to the growing form of the bacillus.

The spores are endowed with wonderful vitality. Freezing, carbolic acid, thymol, salicylic acid, beta naphthol, perchloride of mercury, as well as creolin, lysol, eucalyptus and naphthalene, which evaporate at the ordinary temperature of the hive, prevent the growth of the bacilli, but have practically no action on the spores. In 5 per cent. carbolic acid the spores persisted



[*From a photograph lent by the Department of Agriculture and Technical Instruction, Dublin.*]

FIG. 1.—Portion of a comb affected by foul brood in an advanced stage. The empty cells are those from which healthy bees have emerged, or which have been occupied by diseased larvæ, the remains of which are not discernible in the print. All the capped cells bear the appearance of containing diseased brood. This is indicated by the sunken cappings of the cells, and the numerous irregular perforations in the cappings.

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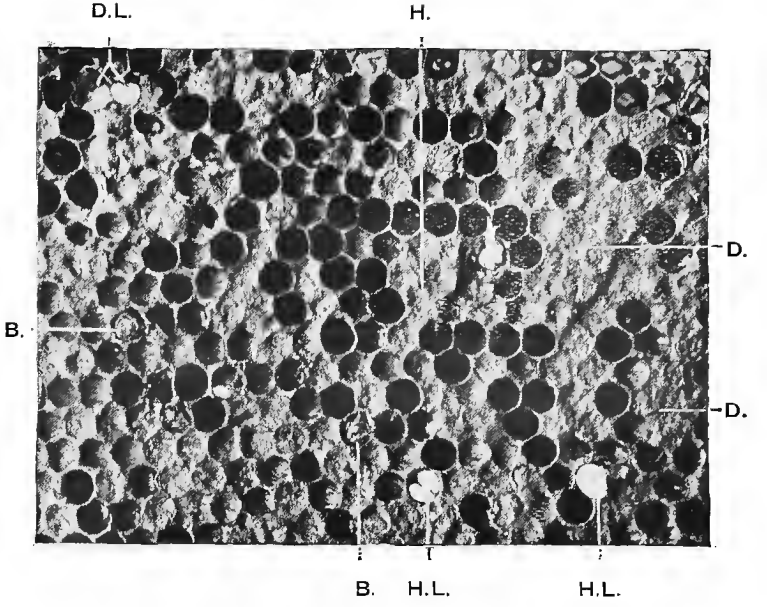

[*From a photograph lent by the Department of Agriculture and Technical Instruction, Dublin.*]

FIG. 2.—Portion of comb affected by foul brood, in a less advanced stage than Fig. 1. The raised cappings indicate that there is a good deal of healthy brood, but the presence of diseased brood all over the comb is indicated by the sunken cappings.

H. A group of cells containing healthy brood; similar cells being observable all over the comb.

D. Two groups of cells containing diseased brood of which there are many more.

B. Healthy bees emerging from their cells.

H.L. Healthy larvæ.

D.L. Diseased larvæ. Note that these larvæ are not lying like the healthy larvæ.

two months; the spores also resisted the boiling temperature of water for 15 minutes. From this it will be seen how great is the difficulty in curing foul brood unless the disease is attacked in its early stages.

" Sour brood " is distinguished from the other types of foul brood by the absence of a spore bearing organism.

Symptoms.—When colonies are found to be weak and are working languidly, with little desire to fly, foul brood may be suspected. If it is present, an examination of the combs will show some cells (many or few) containing dying or dead larvæ, and others with their cappings sunken or perforated (*see illustrations*), the cells of healthy brood being usually compact, and the larvæ plump and of a pearly whiteness.

When a colony is attacked by the *strong smelling* foul brood (*Bacillus alvei*, Cheshire & Cheyne), the larva begins to move unnaturally and loses its characteristic plumpness and its white colour assumes a flabby appearance and lies at the base or lower side of the cell. The colour changes to pale yellow, then to brown, and when the larva begins to decompose the mass becomes paplike or gluey, and shows slight ropiness. The difference in the decomposed larva depends on the proportion of " sour brood " associated with this form of foul brood. If the former predominates the mass is paplike, and if the reverse is the case the decomposed larva is of a gluey and slightly ropy consistency. In every case a most disagreeable stench, resembling that given off by bad glue, is emitted, and in an advanced stage of the disease the foul odour may frequently be detected at a considerable distance from the hive. The foul mass in the end dries up in the cells and leaves only a *smooth* dark brown scale adhering to the lower side of the cell, and this scale is difficult to remove.

In the *odourless* foul brood (*B. Burri*, Burri; *B. Brandenburgiensis*, Maasen; *B. larvæ*, White) the progress of the disease is much slower, as the larvæ are usually affected at a later stage, just before or after they are sealed over. The diseased larva lies extended on the bottom side of the cell, and soon assumes a brown colour. The decomposed mass is odourless, and on inserting a piece of stick into one of the cells, it will have adhering to it on withdrawal a ropy coffee-coloured mass, which can be drawn out in a fine thread before it breaks. The resultant dry scale, which is dark brown and *rough*, sticks to the lower side of the cell. The cappings of the affected cells are very much more depressed, are darker in colour, and sometimes perforated with irregular holes.

In *sour brood* (*B. Güntheri*, Burri; *Streptococcus apis*, Maasen) the larva is attacked while still curled up, and after death it changes first to a greyish, and then to a yellow colour, and there is a strong odour resembling that of vinegar. The remains are easily drawn out of the cell without rupturing the

chitin covering. Sour brood is seldom found by itself, but is usually associated with the strong-smelling form of foul brood.

It should be noted that " chilled brood " must not be mistaken, as it very frequently is, for foul brood. The dead larvæ of " chilled brood " turn first grey, and afterwards become nearly black, whereas in foul brood the larvæ turn at first pale yellow and then brown, except in " sour brood," when they turn from grey to yellow. The larvæ in " chilled brood " are also generally removed by the bees, which seldom attempt to carry away larvæ which have died from disease, unless disinfectants to arrest decomposition are used.

Sources of Infection.—Experience has plainly shown that with foul brood—as in all epidemic diseases—the weak, sickly, and badly nourished colonies are specially liable to take the disease, and become centres of infection.

1.—A diseased colony becomes too weak to defend its stores; robbers from healthy neighbouring colonies then descend upon it and probably steal the honey, and in doing so carry away the seeds of disease and death, which are thus spread, until all the colonies of a neighbourhood may be fatally affected. Unless a disinfectant is used the bees do not seem to have the power to clean out the foul cells, which consequently remain as centres of infection within the hive.

2.—Another very important point is that the bee-keeper may himself be the means of spreading the disease by indiscriminately manipulating, first diseased, and then healthy colonies without taking proper precautions to disinfect both himself and the appliances used.

3.—Combs which have contained foul brood retain the spores. The queen lays eggs in the cells or the workers deposit their honey and pollen in them. The honey and pollen in this way become vehicles for the transmission of the disease to the larvæ in the process of feeding by the nurse bees. Under no consideration should infected hives or combs be exposed to the visits of bees. Carelessness in this respect may work immense mischief to neighbouring colonies and apiaries.

Prevention and Remedies.—1. The hives should be placed in suitable positions, and be kept clean, well ventilated, and weather-proof.

2.—In endeavouring to get rid of foul brood, efforts must be made to raise to a high standard the lowered vitality of the bees, which first enables the germs of the disease to develop. Strong colonies only, with young and prolific queens should be kept, while good wholesome food, and freedom from dampness are also important. The combs in the brood chamber should be frequently renewed. At least two frames fitted with full sheets of wired worker base foundation should be inserted in each colony, every spring.

3.—When the bee-keeper has been in contact with diseased stocks, the appliances used, and also the hands, must be washed with carbolic soap, or with a solution of one ounce Calvert's No. 5 carbolic acid in 12 oz. of water. Before washing the appliances and the hands with the disinfectant, all propolis, which is insoluble in water, must be removed by rubbing with a small piece of cloth saturated with methylated, or other, spirit.

4.—It was formerly thought that honey was the only source of infection, and that if bees were starved until they had got rid of the honey carried by them from the diseased stock, a cure would be effected. It is now known that the starvation method often fails when it is not supplemented by disinfection of hives, &c.

5.—When the disease is discovered in a weak colony, the destruction of bees, combs, frames, and quilts, together with a thorough disinfection of the hive, is by far the best course to pursue. The spores are then destroyed, and the source of infection removed. The bees may be killed by pouring ½ oz. of saturated solution of cyanide of potassium into the brood chamber of the hive, turning back a corner of the quilts for this purpose, having first taken the precaution of seeing that the quilts fit properly, and also that the entrance is securely stopped up with earth to prevent the escape of the fumes. Another method is to sprinkle powdered sulphur on the fuel in the smoker, see to the quilts and block up the entrance with earth, as described above, then make a hole through the earth just large enough to admit the nozzle of the smoker so that the sulphur fumes may be blown into the brood chamber until all the bees are suffocated. When the bees are all dead destroy the combs, quilts, and dead bees by burning. This is best accomplished by digging a hole in the ground eighteen inches deep and one yard in diameter, in which the material is burnt. When this is reduced to ashes fill in the hole with earth so that the possibility of infection is entirely removed. Both these operations must be carried out at night, when the bees have ceased to fly. The hive should then be disinfected by scorching the interior with a painter's blow lamp, or, failing this, the interior should be painted with petrol or paraffin oil, which, when lighted, will disinfect by scorching the surface of the wood. After the outside has been well painted with oil paint, the hive will again be ready for use.

6.—If an affected colony be still strong, the bees may be preserved by making an artificial swarm into a skep or swarm box. The bees should be confined in the skep or box, in the former case by tying over the mouth some open material for ventilation purposes, such as scrim cloth; in the latter case ventilation is already provided. They should be kept confined in a cool place, such as a cellar, for 48 hours

without food, by which time all the honey they may have taken with them will have been consumed, and such of the bees as are diseased will have died. If the bees are confined in a skep, the latter should be placed mouth upwards while in the cellar or other cool place. At the end of the period of starvation the bees should be hived into a moveable comb hive in the same manner as a swarm. They are then fed for at least a week on syrup to which as much Napthol Beta as can be heaped on a threepenny piece has been added to every pound of *white* cane sugar used; the Napthol Beta may be dissolved in methylated spirit, sweet spirit of nitre, or whisky, and added to the syrup while warm but not hot. If a swarm box is used it should be disinfected by scorching when empty, and if a skep, it should be burnt. In both these cases the bees which die during treatment should be burnt.

Note.—In the case of mild attacks disinfection or fumigation may be resorted to with success, Formaldehyde being the chief agent used. To accomplish this, tack a sponge or piece of flannel on the back of the division board and soak this every six days with 1½ oz., 40 per cent. Formaldehyde, at the same time keeping a continuous supply of two balls of Napthaline in the brood chamber of the hive. In attempting these remedial measures, however, or other remedial measures of the nature described above, it would be desirable, wherever such help can be procured, to seek the advice of an expert bee-keeper.

DISEASES OF ADULT BEES.

Much attention has recently been paid to diseases of adult bees. The term "Isle of Wight Disease" has become ambiguous, as it appears to cover two distinct diseases:—

(1) Nosema Disease, or Microsporidiosis, caused by a protozöon, *Nosema apis* (Zander);

(2) Acarine Disease, caused by *Tarsonemus Woodi* (Rennie).

From time to time other diseases have been reported from various parts of the world, but not much is known as to their causes and they do not appear to be of much importance in this country.

Nosema Disease (*Microsporidiosis*).

In the first investigations on the disease sometimes called Isle of Wight Disease, it was supposed that *Nosema Apis* was the causal agent. Recent investigations, however, have shown that this is not the case but that *Nosema* is a separate disease.

Nosema disease is not confined to the British Islands, but has been found in Switzerland, Italy, Australia, America, Canada, Germany and Denmark. This goes to show that the

occurrence of the disease is not governed by climatic conditions.

The disease is an insidious one, and in its first stages can only be detected by examination with a microscope. For this reason it often becomes well advanced before its presence is suspected. Colonies, apparently healthy, often reveal a high percentage of infection when the bees are subjected to microscopical examination.

The disease is caused by a microscopic animal parasite consisting of a single cell, which is present in vast numbers in the walls of the chyle-stomach and intestine of diseased bees. This protozöon has been given the name of *Nosema Apis*, Zand., and, as it belongs to the group called the *Microsporidia*, the disease has been named *Microsporidiosis*.

During its short life *Nosema Apis* passes through three stages. First, on emerging from the spore, it is known as a "planont," on account of its capacity to move from place to place; during this stage it wanders in search of a convenient cell in the body of the bee which it can penetrate. As soon as it has entered a cell, the parasite loses its capacity to move and passes into the second stage of its life history, when it is called a "meront." During this stage it feeds, grows, and multiplies enormously, and after a series of changes, each daughter form becomes a spore. The spore is the third form of the *Nosema*, and it is in this form that the parasite spreads from one colony of bees to another. The spore has a hard protective coat and is about one-thousandth of the size of a grain of rice, which it resembles in shape. Both planonts and meronts can increase in number by division, though the meronts have a greater capacity in this direction than the planonts. The rate of increase is important since there is reason to believe that the virulence of the epidemic depends on the circumstances which favour the rapid increase or otherwise of the *Nosema* in the intestine of the bee. Further it should be noted that it is the increase in numbers that causes disease in the infected bee.

The symptoms of the disease are so variable that until recently *Nosema* disease has been referred to under several different names. In its least harmful form it develops slowly and kills very few bees, while the colony is often replenished by the young bees that emerge from the cells. In this form it is commonly termed "spring dwindling," and frequently escapes the notice of all but expert bee-keepers. In other cases the disease is diagnosed as "starvation." The loss of foragers causes a diminution in the income of food supplies, and eventually the colony dies from starvation. It is possible that the combs, if subsequently made use of, may start the disease at indefinite intervals. At other times, especially in the spring, the mortality is so great as to prevent the colony from gathering surplus.

Nosema disease is an infectious disorder of adult bees and attacks both the queen and drone as well as the worker but not the brood. The chief sources of infection are the drinking places visited by bees; stagnant pools should not be allowed, there being less danger in running water.

The resistance* of the disease is as follows:—

1. *Nosema Apis* suspended in water is destroyed by heating for 10 minutes at about 136° F. (58° C.).

2. Suspended in honey, *Nosema Apis* is destroyed by heating at about 138° F. (59° C.).

3. *Nosema Apis*, drying at room and outdoor temperatures respectively, remains virulent for about 2 months; at incubator temperature about 3 weeks and in a refrigerator about 7½ months.

4. *Nosema Apis* suspended in water is destroyed by exposure to the sun's rays from 37 to 51 hours. (Hence it is advisable not only to control the water supply to the bees, but also to have it regularly exposed to the sun's rays; at the same time a board should be so arranged above that the bees cannot drop their fæces into the water. A glass water fountain is superior to one of zinc, or to a metal or wooden pail or tub.)

5. *Nosema Apis* remains virulent in honey for from 2 to 4 months.

6. *Nosema Apis* in the bodies of dead bees lying on the soil ceases to be virulent in from 44 to 71 days.

7. *Nosema Apis* is readily destroyed by carbolic acid, a 1 per cent. aqueous solution destroying it in less than ten minutes.

Remedial and Preventive Measures.—No certain remedy has been discovered for *Microsporidiosis*, most cases of so-called cures that have been investigated having been based on faulty observations. A few recommendations, however, can be given for preventing the spread of disease, and for mitigating its severity when it appears.

1. *Cleanliness.*—Great care should be taken to keep the hives and the surroundings of the apiary clean. Cleanliness will not in itself secure immunity from disease, but dirty or damp surroundings lower the vitality of the bees and render them more liable to attack. All bee-keepers who can give the necessary time to their attention should adopt British standard frames and moveable comb hives, but those only able to use skep hives should renew them every two or three years.

After an outbreak of disease the interior of all moveable comb hives should be charred with a painter's lamp as advised in the text books. They should not be used again for several weeks. All skeps, quilts, old combs, and dead bees should

* White, G. F., *Nosema Disease*, U.S. Dept. of Agriculture Bull. 780, 1919.

be burnt and the soil round the hive turned over and sprinkled with paraffin and then dug over and covered with quicklime.

2. *Drinking Water.*—Water is required by bees at all times when they can leave the hive, though only sufficient is taken to serve the needs of the colony for a short time.

A great deal of water is carried into a hive at the height of the breeding season. It is collected, on dewy mornings and after showers, from the blades of grass and the leaves of other plants. In dry weather bees resort to streams and ponds, certain selected spots being made use of. They often select dirty pools of warm stagnant water rather than take clean water that is colder. In showery weather, water is probably a greater source of infection than in dry weather. The bright intervals which permit the gathering of water are also utilised for cleansing flights by many bees. Since the excrement of infected bees is often full of spores, many of the puddles and drops must be highly contaminated where infected bees are present.

3. *Movement of Bees.*—It need hardly be said that bee-keepers who live in districts which are free from disease, should on no account purchase swarms or driven bees from an infected area. There is no surer way of spreading disease than by transferring bees from one district to another, for swarms even from apparently healthy colonies sometimes develop disease when placed in new hives. It is probable that all the parasites have not the same degree of virulence, and that the passage of the parasite through successive bees may increase its virulence. It is, therefore, important to prevent the disease being spread by parasite-carriers; that is, bees in which the parasite is present without the disease showing itself. These parasite-carriers may be divided into two classes: (1) those which have come in contact with diseased individuals, and have in some other way acquired the organisms without contracting the disease; and (2) those which have suffered from the disease, often in a slight and modified form, and have subsequently continued to harbour the organisms for long periods.

Either of these classes of parasite-carriers may spread disease if brought into contact with susceptible stocks, so clearly it is equally dangerous to introduce bees from a disease-free district, into a neighbourhood where disease abounds. Bee-keepers in such districts should, therefore, if they wish to acquire fresh colonies, purchase them in the immediate neighbourhood where there is a possibility that the bees are capable of resisting any infection with which they are likely to come into contact.

4. *General Management.*—Finally, bee-keepers must remember that much may be done by careful and proper management of their apiaries. It cannot be stated too emphatically that the production of disease depends on many

important factors besides the mere introduction of the infecting agent, though of course, *Nosema* disease cannot arise unless *Nosema* is introduced. Every infected bee dies sooner or later in consequence of the infection, but parasites sometimes occur in small numbers and reach the spore stage without apparently affecting the health of the bee. Old spores from dead bees seem to be less virulent than fresh spores from bees recently dead of the disease, and there is some reason for believing that while unsuitable food, and damp or unhealthy conditions, are favourable to the more ready development of the parasite, suitable food and favourable conditions increase the natural resistance of the bees, and, at least for a time, keep the symptoms of the disease in check. Requeening at regular intervals, if practised systematically, is a valuable aid in combating disease.

In comparison with Acarine Disease the following conclusions are interesting:—

1. There is a disease produced by *Nosema* which is infectious.

2. That although *Nosema* may be present it does not always produce the characteristics of Acarine disease (so called "Isle of Wight" disease), and that this disease may exist without *Nosema* being present.

3. Drs. Graham-Smith, Fantham and Porter found no spores of *Nosema* in 13 out of 66 cases of "Isle of Wight" disease investigated. If *Nosema* were the cause of the disease it should have been found in every case.

4. Crawling is one of the chief characteristics of Acarine disease, whereas *Nosema* may be present in large numbers without the bees showing any signs of crawling.

5. Infection with *Nosema* does not produce the characteristics of Acarine disease.

6. In *Nosema* disease the colony may appear healthy, the only symptom being the heavy mortality of bees.

7. In Acarine disease "crawling" is one of the chief characteristics. Dr. Porter has stated that in some bees showing the "crawling" symptoms and sent for diagnosis no *Nosema* was found. Dr. Graham-Smith also found nothing special in bees sent to him from a crawling colony.

8. Dysentery, frequently present, but not invariably evidenced in Acarine disease is not a primary symptom, and may be due to other causes.

9. In Acarine disease the queen is often the last to succumb, while in *Nosema* she may be amongst the early victims.

Acarine Disease.

In the past few years investigations have been carried out in Aberdeen under Dr. John Rennie, which have resulted in the discovery of a parasite belonging to the genus *Tarsonemus*, hitherto unknown in bees.

This parasite breeds within the bee and is confined to an extremely limited, but very important region of the breathing system—the first pair of tracheæ of the thorax. The multiplication of the mite causes this to become either partially or wholly obstructed. In the latter case the bee dies at once, while in the former, being unable to fill the air sacs which permit of flight, the bee is reduced to crawling (one of the symptoms of the disease). In this case also the fæces are not evacuated, as normally this is accomplished on the wing, and hence arises a congested condition of the bowel and a consequent staining of the combs, hive front and alighting board (another marked symptom of the disease).

Acarine Disease in Summer.*

Since our knowledge of Acarine Disease is steadily advancing it is probably more satisfactory not to offer advice beyond that applicable to the present season.

First Signs of Disease.—If a stock begins to show signs of listlessness and works indifferently, if the bees come up and loiter on the tops of the frames when the hive is opened, or if an excess of brood for the number of adult bees is noticeable, the bee-keeper will do well to have the bees tested for the presence of Acarine Disease. The Ministry of Agriculture will do this for a nominal fee. It should be noted that when "crawling" from this disease has become an obvious feature in a stock, the proportion of affected bees is already dangerously high and the degree of infestation within the bees is past remedy. Therefore, do not wait for the appearance of "crawlers." Act at once.

It cannot be too strongly emphasised that from the practical standpoint the most important thing for the bee-keeper in relation to this disease is to prevent stocks remaining stationary or going down in numbers of bees. He must bear in mind that, viewed practically, the control of Acarine Disease is a problem of counteracting the spread of a destructive parasite from bee to bee. While he may not be able to do this directly, the bigger the stock built up at the critical time the less important the parasite becomes from his point of view.

The secret of success in management of the disease in summer is therefore to work for the maximum of young foragers at the time of the honey flow.

In the writer's opinion the readiest way in which this can be effected is to head all doubtful stocks with this year's queens as early in the season as possible.

Remember that such a queen can produce bees faster than disease can destroy them.

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* Reprinted from a leaflet published by the Aberdeenshire and Kincardineshire Bee-Keepers' Association and written by John Rennie, D.Sc., F.R.S.E., Lecturer in Parasitology, University of Aberdeen.

Stocks thus saved, even temporarily, can be maintained with profit.

Swarms in Relation to Disease.—It is a very general occurrence, when affected stocks swarm, for extensive crawling to develop within a short period afterwards, and this is frequently the first indication to the owner that his bees are diseased. Therefore stocks preparing to swarm should be closely watched for the suspicious signs mentioned above and also for the beginnings of crawling. If these are recognised it will be well to make an artificial swarm and to give a new queen to the parent stock with the young bees on the new site. This is a ready method of separating the older infected bees from the younger. Watch closely the lot on the old site (the older bees).

If the swarm crawls heavily it should be destroyed.

There is risk in purchasing swarms from infested districts.

Danger of Robbing.—Disease is spread through robbing. In the interests of the bee-keeping community, bee-keepers should not afford facilities for robbing by keeping stocks weak from disease.

Remember that in this matter the robbers suffer rather than the robbed.

Drones.—If you are not requiring drones, do all you can to keep them out of your hives. Diseased drones pass from stock to stock and thus actively spread the trouble.

Prevention rather than Cure.—Finally, it may be suggested that the movement of colonies of swarms throughout the country should be restricted as far as possible, unless these have been previously tested and found free from disease. Whatever cures may eventually become available, there is as yet no royal road to the eradication of Acarine Disease, but intelligent application of the suggestions given above is likely to enable the bee-keeper to carry on with some degree of profit in the meantime, and to develop a system of prevention which in the long run is more valuable than cure.

Dysentery.

Symptoms.—Bees afflicted with dysentery discharge their excrement on the interior walls of the hive, on the surface of combs and on the floor board, the evacuations being usually of a dark colour, cloudy in appearance with an extremely offensive odour. While dysentery may be a symptom of either of the two foregoing diseases, the condition also arises (usually towards the end of winter and in the early spring) if the bees have been confined in the hive for a considerable period.

Causes.—The main causes of the disease are:—

(1) Unsuitable food, such as honey which has fermented;
(2) Unsealed stores for winter which contain too much moisture;
(3) Honey dew as stores, eaten in the winter;

(4) Impure cane sugar, beet sugar, or brown sugar used for artificial feeding; the latter is frequently fatal as it contains a large percentage of molasses and other foreign matter;

(5) Glucose used for artificial feeding; and

(6) Damp and badly ventilated hives.

Bees when in a natural and healthy condition void their fæces when in flight, thus keeping their hive clean. During the winter and early spring months there are often protracted periods of bad weather during which the bees are confined to the hive, and so are unable to take the cleansing flights which they would naturally do on every suitable warm day. If during these periods of inactivity the bees consume food containing an excessive amount of waste matter, the intestines become abnormally distended with the products of digestion and being unable eventually to retain these, dysentery is the result.

The bee-keeper who delays till the late autumn what artificial feeding may be necessary, and who then supplies syrup containing too much water, is courting disaster; for at this time of the year the temperature is generally too low for the bees to evaporate the excess of moisture necessary for ripening purposes, and if this does not take place they do not hermetically seal the stores with wax cappings. If feeding is necessary, it should be completed in good time, and the white cane sugar syrup given should be as dense as possible so that the bees may store and seal it over with the least possible delay. It is much better, when possible, to winter the bees on their natural food, which is good sound stores of honey, properly sealed. Artificial food should be given to supplement and not as a substitute for their natural food.

Disturbing bees during the winter months is also likely to cause dysentery, as it excites them and causes them to consume a larger amount of food than they would do under normal conditions.

Treatment.—If a colony becomes affected with dysentery, remove all the combs not covered by bees, close up the remaining combs with the division board, see that the interior of the hive and its fittings are dry, give ample ventilation by opening the entrance, and put a cake of warm candy over the cluster of bees. If the outbreak occurs when the weather is warm enough to manipulate the combs, a clean hive should be warmed inside by exposing it to the heat of a fire and the combs and affected bees transferred to it. In both cases should the bee-keeper have by him combs containing sealed honey, these should be warmed and given to the bees in place of the stained combs of food removed and in preference to candy.

APPENDIX—ACARINE DISEASE: EXAMINATION OF BEES.

The Ministry of Agriculture and Fisheries wishes to inform bee-keepers that bees can now be examined for the presence of Acarine Disease, on payment of a fee of 2s. for each sample submitted. The following instructions should be carefully observed:—

(1) Specimens should be *live* bees, of about 30 in number, taken from off the combs and not collected from outside the hive. It is in this way only that the true condition of the colony can be diagnosed. *Dead* bees will not be accepted as they are unreliable for microscopic examination.

(2) The bees should be placed in a small cage or box, preferably of wood, provided with ventilation holes, and having a piece of muslin fastened across the inside for the bees to cling to during transit.

(3) A supply of candy sufficient to last for a few days, or a lump of sugar moistened with water, should be wrapped in muslin and firmly fixed to the inside of the box.

(4) The box should be secured with string and a label attached addressed to the Secretary, Ministry of Agriculture and Fisheries, Whitehall Place, S.W.1, with the name and address of the sender written on the reverse side, but crossed through to prevent an error in the post.

(5) Not more than three samples may be submitted by a bee-keeper at any one time, but further samples may be sent at intervals of four days. In all cases where more than one sample is sent at a time, these should be numbered 1, 2 and 3 as the case may be.

(6) At the same time as the bees are despatched, a remittance at the rate of 2s. for each sample submitted should be forwarded under separate cover. No bees will be examined unless or until this remittance has been received. Payment should be made by cheque or Postal Order payable to the order of the Ministry of Agriculture and Fisheries, and not to any individual by name, and crossed "Bank of England." Postage stamps will not be accepted. The Ministry will not be responsible for any loss occasioned by inattention to these instructions.

(7) In the letter forwarding the remittance, as much information as possible should be given with regard to the past history and present condition of the stocks from which the bees were taken. This may help the Ministry in giving advice when furnishing a report of the examination, and will assist in general bee disease research.

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